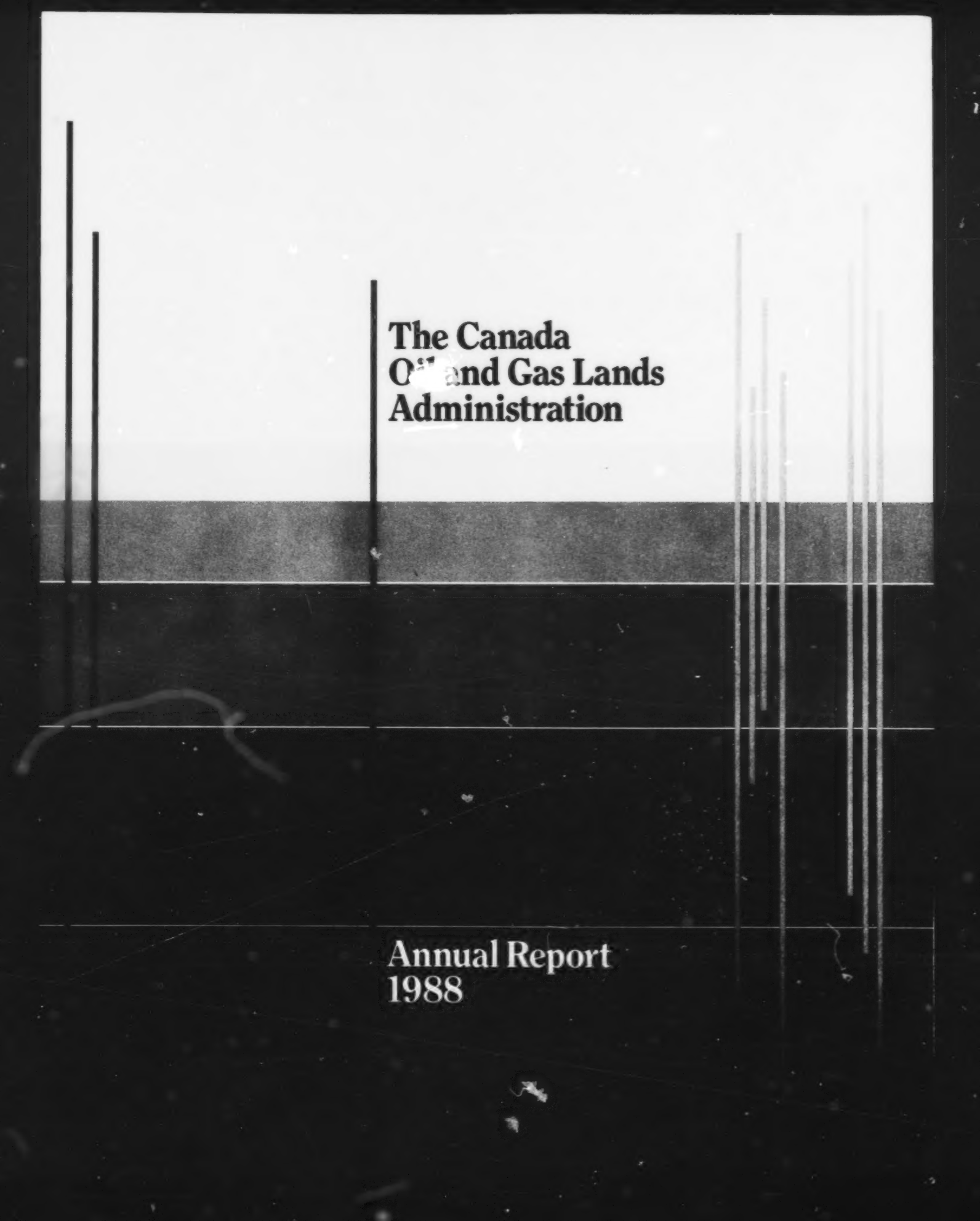


The Canada Oil and Gas Lands Administration

Annual Report 1988

89-05729/

Corporate Profile

The Canada Oil and Gas Lands Administration (COGLA) was established in 1981 by a memorandum of understanding between the Minister of Energy, Mines and Resources and the Minister of Indian Affairs and Northern Development.

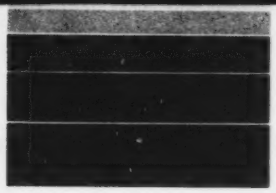
COGLA is the Government of Canada's principal contact with the oil and gas industry in matters relating to the regulation of oil and gas activity on Canada's frontier lands. These lands include Yukon Territory, the Northwest Territories, Hudson Bay and most of the country's offshore areas. The Canada-Newfoundland Offshore Petroleum Board has operational responsibility for the Newfoundland and Labrador offshore. A new Canada - Nova Scotia Offshore Petroleum Board with operational responsibility for the Nova Scotia offshore will be established on proclamation of legislation implementing the Canada - Nova Scotia Accord.

COGLA's prime responsibility is the regulation of the exploration for and the development and production of oil and gas on frontier lands in a manner that promotes safety of the worker, effective resource conservation, protection of the environment, and full and fair access by Canadians to the benefits arising from activities related to hydrocarbon resources.

COGLA has five branches:

- Rights Management Branch
- Engineering Branch
- Resource Evaluation Branch
- Environmental Protection Branch
- Policy Analysis and Coordination Branch

COGLA's regional office in Halifax has operational responsibility for the Nova Scotia offshore; the Yellowknife office has similar responsibilities in the North. These offices regulate the Canada Benefits, and the geological and engineering aspects of oil and gas exploitation activities by issuing authorizations to drill wells, monitoring reports and other data submitted on operations, and conducting regular on-site inspections.



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Message from the Minister of Energy, Mines and Resources, the Honourable Jake Epp

Minister Jake Epp

I am pleased to submit to Parliament the seventh annual report of the Canada Oil and Gas Lands Administration (COGLA), the organization created in 1981 to regulate oil and gas exploration, development and production activities on Canada's frontier lands. COGLA continues to play an important role in implementing this government's Frontier Energy Policy and in ensuring that offshore petroleum activities are carried out in a manner that promotes the safety of workers and the protection of the environment.

This was a significant year for Canada and the Newfoundland offshore in particular. In July the governments of Canada and of Newfoundland and Labrador signed a statement of principles with Mobil Oil Canada Ltd. and its partners on the development of the Hibernia oil field. The Hibernia statement of principles, like the Atlantic Accord, confirms this government's belief that significant economic rewards can be achieved when provinces are treated as equal partners in Confederation. The importance of Hibernia lies not only in bringing on stream future oil supplies or in the number of jobs it will generate, but in the opportunity for Canadians and Newfoundlanders to acquire expertise in offshore technology and in the management of major offshore projects. The federal government supports this project because it will provide unique opportunities for our offshore energy industry to expand and compete for future offshore projects in Canada and throughout the world. Hibernia is an investment in our future. I am happy to report as well that survey contracts have already been awarded to Canadian companies and that bids on major project contracts have been invited.

In June an environmental action plan was released, which maps my department's approach to the important issue of making exploration, development and use of our energy resources compatible with the protection of our environment. COGLA, as the regulatory agency responsible for the exploration and development of our offshore oil and gas resources, plays an important role in developing regulations, standards and guidelines for environmental protection. Many of COGLA's standards and guidelines are internationally recognized. In addition, the independent offshore oil and gas boards established under the East Coast accords incorporate environmental concerns into their deliberations. These include assessments of potential impacts on marine and coastal flora and fauna, proposed oil-spill counter measures and waste-treatment technologies, as well as the potential effects of the weather, the ocean and ice on the safety of offshore operations.

The Canada – Nova Scotia Accord implementation legislation received royal assent in 1988 and steps were taken to have a new independent offshore petroleum board in place when the legislation becomes law. The legislation also incorporates amendments to implement the decision taken in April 1988 by the governments of Canada and of Nova Scotia to place a moratorium on oil and gas exploration on Georges Bank until the year 2000.

The legislation provides for a future public review by an independent panel on the environmental and socioeconomic impacts of petroleum exploration on Georges Bank.

Operators continued their successful delineation programs at the Terra Nova and Whiterose oil discoveries. Petro-Canada awarded a contract in April to SNC/AKER to carry out a preliminary engineering study to evaluate alternative development scenarios for the Terra Nova field. These encouraging developments are promising signs of what is to come in the years ahead for Canada and the Newfoundland offshore.

I remain hopeful for the future of the Nova Scotia offshore. We know that the oil and gas resources are there and that in time these resources will be developed for the benefit of Nova Scotians and all Canadians.

I was pleased to note that the enhanced safety regulations, developed by COGLA in response to the recommendations made by the Royal Commission on the *Ocean Ranger* Marine Disaster, contributed to the safe evacuation of the 27 men and women from the *Rowan Gorilla 1* drilling unit when it sank in the North Atlantic in early December. The crew of the drilling unit praised the training they had received while working offshore Nova Scotia for saving their lives.

I firmly believe that oil and gas policies initiated by this government will continue to be an important driving force in the development of Canada's regional economies.

Message from the Minister of Indian Affairs and Northern Development, the Honourable Pierre H. Cadieux

I am happy to join my colleague the Honourable Jake Epp, Minister of Energy, Mines and Resources, in submitting to Parliament the seventh annual report of the Canada Oil and Gas Lands Administration.

In 1988 the federal government reinforced its commitment to promote political and economic development in the North when it signed separate agreements-in-principle (AIPs) on a Northern Accord with the governments of the Northwest Territories and Yukon. These agreements honor the pledge made by the government in the Frontier Energy Policy of 1985 and again in the Northern Political and Economic Framework of 1987. Final agreements on a Northern Accord would transfer to the territories the administrative and legislative powers to manage oil and gas resources in the northern onshore areas and would provide for joint management of the offshore areas.

Another facet of the government's Northern Political and Economic Framework has been to settle native land claims. In 1988 we continued to implement the 1984 final agreement with the Inuvialuit of the Western Arctic. In September an AIP was signed to settle the Dene-Métis land claim in the western Northwest Territories. The government also ratified an AIP with the Council of Yukon Indians in March 1989.

The AIP on a Northern Accord, land claims and other similar agreements will, over time, significantly change the current process of regulating oil and gas exploration and development activities in the North. The critical challenge facing governments, Northerners and industry will be to continue fostering the spirit of cooperation now in place as we move from the existing oil and gas management and regulatory regime to a new regime which will be created upon full implementation of accord arrangements and claim settlements. This new regime will create a climate of greater certainty, stability and opportunity for the oil and gas industry in the North.

Although the number of exploratory wells in the North in 1988 was slightly less than last year, geophysical activity increased dramatically, with a trend toward three-dimensional site surveys. This indicates that industry remains interested in exploring and developing the North's hydrocarbon potential.

Panarctic continued seasonal production at the Bent Horn oil production facility in the Arctic Islands. The company sent two shipments of oil to northern and southern markets. Part of one shipment was dropped off at Resolute for use by the Northwest Territories Power Corporation.

Gulf continued its delineation program at the Amauligak discovery. Commercial development of this significant discovery will depend on many economic factors, including oil prices. The operator and its partners continue to examine conceptual engineering for field development and pipeline construction.

Esso and Shell submitted applications to the National Energy Board (NEB) for export licences to produce and export gas via a pipeline from existing discoveries in the Mackenzie Delta–Beaufort Sea region to the United States (Gulf submitted a similar application to NEB early in 1989). Public hearings by NEB will be held in 1989 to determine whether export licences should be granted and, if so, under what terms and conditions. Other regulatory approvals will also be required before development and production can proceed.

I believe that this government's Frontier Energy Policy and market-oriented policy with respect to oil and gas exploration and development will continue to bring economic benefits to the North. Our government's role is to continue to work together with territorial governments, industry and Northerners in putting the mechanisms in place to develop the hydrocarbon resources of the North, while ensuring that activities are carried out safely and without harm to the environment.

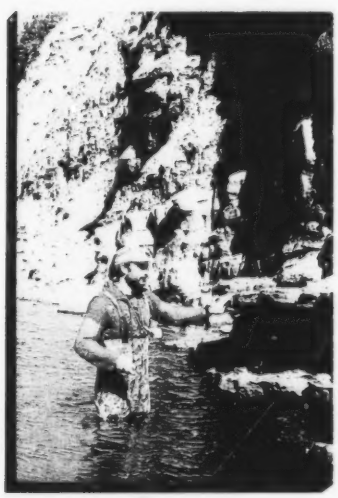
Minister Pierre H. Cadieux

Canada's Frontier Lands

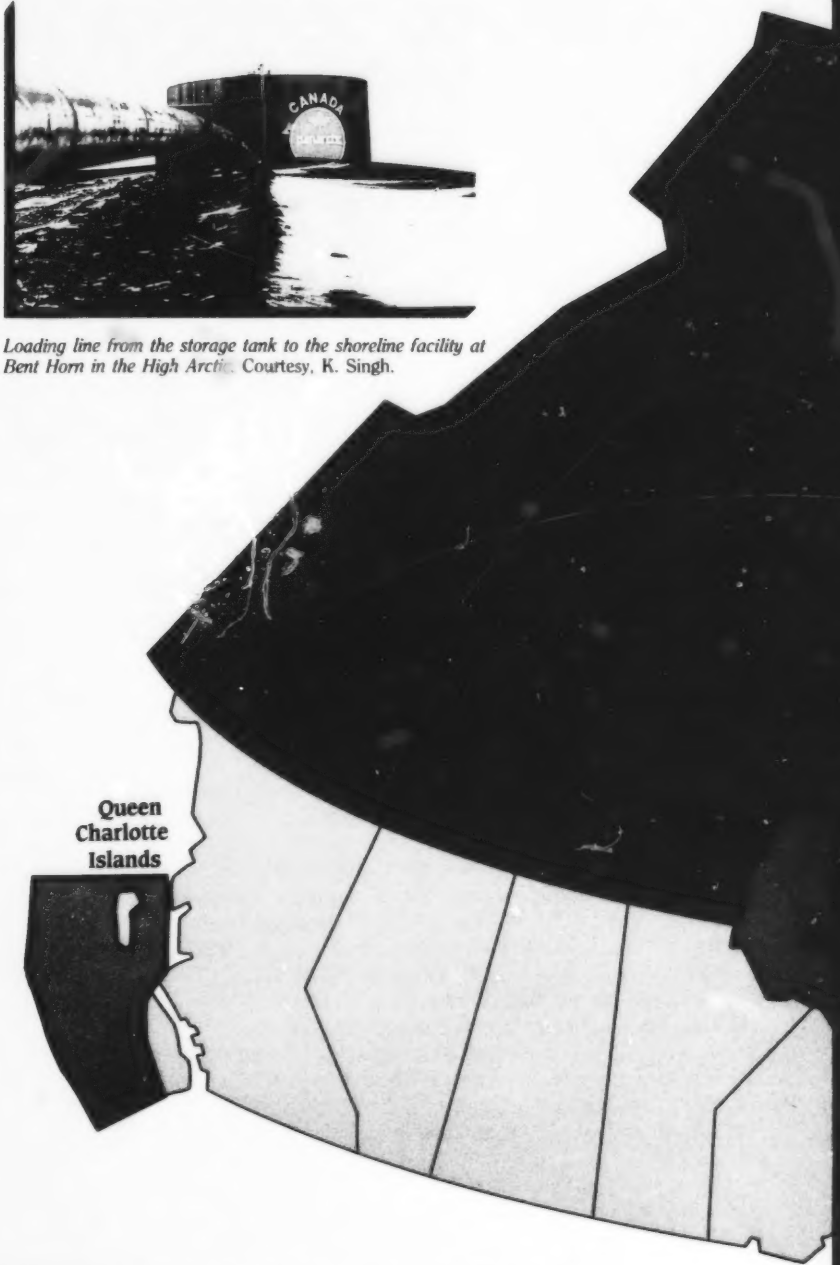
The Kulluk conical drilling unit with a standby vessel during a test of the Amauligak O-86 well in the Beaufort Sea.
Courtesy, B. Gallagher.

Loading line from the storage tank to the shoreline facility at Bent Horn in the High Arctic. Courtesy, K. Singh.

A geologist at work in the Richardson Mountains, northern Yukon.
Courtesy, G. Morrell.



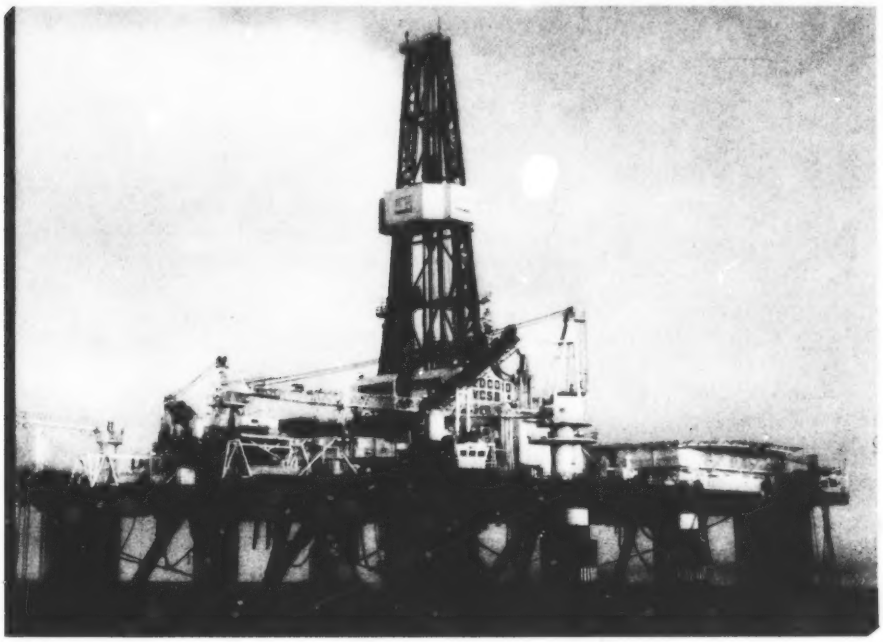
A view of the Pacific Ocean from South Moresby Island, B.C.
Courtesy, U. Schmidt.



Area under the responsibility of the Minister of Energy, Mines and Resources

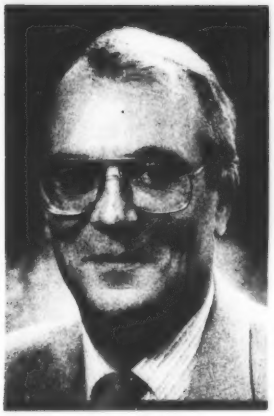
Area under the responsibility of the Minister of Indian Affairs and Northern Development

The Sedco 710 *during testing at the Terra Nova oil discovery.* Courtesy, Petro-Canada Resources Inc.



The MV Sable Sea, *a support vessel used by divers to abandon two suspended Mobil wells on the Scotian Shelf.*
Courtesy, Secunda Marine Services Limited.

A Word from COGLA's Administrator, Maurice Taschereau



Mr. Maurice Taschereau

Exploration activity on Canada's frontier lands in 1988 continued at a reduced level because of fairly low oil prices and uncertainty about future prices.

For the past few years, much of COGLA's efforts have been aimed at establishing a frontier resource management regime based on the principles set out in the Frontier Energy Policy. The transition from a centralized approach to a regional and joint management approach is progressing steadily.

Several key initiatives are now in place that have brought much needed stability to the industry operating on the frontier lands. In the Canada Petroleum Resources Act (CPRA), we now have a simplified, competitive and consistent regulatory system for issuing and managing exploration rights on frontier lands — a system that is fair to both industry and Canadians.

The Canada-Newfoundland Offshore Petroleum Board has been responsible for administering and regulating the Newfoundland offshore for the past two years. The board and COGLA have made progress in developing memorandums of understanding with federal and provincial departments. These memorandums ensure coordination in areas such as environment, fisheries, benefits and marine safety. With consent from the Minister of Energy, Mines and Resources, the independent board issued its first call for bids under the new management regime in March 1988. As a result, two exploration licences were issued in November.

The Canada - Nova Scotia Accord implementation legislation received royal assent in 1988. The two governments are now preparing to set up a new independent offshore petroleum board. Once the legislation is proclaimed, the new board will assume legal responsibility for managing the offshore and will replace the current Canada - Nova Scotia Offshore Oil and Gas Board.

The implementing legislation for each of the East Coast accords combines provisions of CPRA and the Oil and Gas Production and Conservation Act (OGPCA). The legislation, therefore, ensures that the regulatory regime in those areas is consistent with regimes in the rest of the frontier lands.

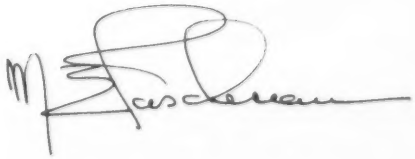
We continue to work closely with the accord provinces, territorial governments, British Columbia, the Canada-Newfoundland Offshore Petroleum Board and the industry to complete proposed amendments to OGPCA, as well as related sections of the implementing legislation for the Atlantic and Canada - Nova Scotia accords. Amendments to the act will enhance existing safety provisions.

The Government of Canada and each of the territorial governments signed agreements in principle on a Northern Accord in September 1988. A Northern Accord will significantly affect the future oil and gas regulatory process in the North. Solving many of the past uncertainties should make the petroleum industry's operating environment more stable and consistent, and renew interest in northern hydrocarbon exploration and development.

During this period of transition and low activity, industry and government must continue laying the groundwork to develop the major discoveries made on frontier lands. To a large extent, this has been accomplished in the Newfoundland offshore with the signing of a statement of principles for developing the Hibernia oil field.

There is much to look forward to. Abundant Crown land is available for issuance of new rights throughout the frontier regions. Over the years, COGLA has collected a wealth of geological and geophysical information and we make it available to industry after the information is released from confidential status. I believe that with more stable oil prices, an increased level of activity is just a matter of time. When that time comes, COGLA and the new independent boards will be ready to meet the demands and challenges.

I would like to take this opportunity to thank the staff at COGLA for their dedication, patience and perseverance during this period of transition.



1988 Highlights

In July the governments of Canada and of Newfoundland and Labrador signed a statement of principles with Mobil and its partners to develop the Hibernia oil field.

In September the Government of the Northwest Territories and the Government of Yukon signed agreements with the Government of Canada on the negotiating principles for a Northern Accord on oil and gas resource management and revenue-sharing.

Parliament passed legislation to implement the Canada - Nova Scotia Offshore Petroleum Resources Accord in July. The Government of Canada and the Government of Nova Scotia are expected to proclaim the accord implementation legislation in 1989. A new independent offshore board will assume the legal responsibility for managing the Nova Scotia offshore on the date the legislation is proclaimed.

During 1988 there were 18 wells active on frontier lands, one more than in 1987. Eight were delineation wells and ten were exploratory wells. Sixteen wells were terminated this year, seven in the North and nine on the East Coast offshore.

The Newfoundland offshore continued to be the most active area of the frontier lands with four delineation and five exploratory wells active in 1988. Petro-Canada continued its successful delineation program at the Terra Nova oil discovery, and Husky delineated its Whiterose discovery.

Gulf completed its current delineation program at the Amauligak oil discovery in the Beaufort Sea. Six delineation wells have been drilled since the Amauligak J-44 discovery of 1984. Recoverable oil reserves at Amauligak are now estimated at more than 79.5 million m^3.

Panarctic continued seasonal production and transportation of oil from its Bent Horn development project in the Arctic. There were two tanker shipments of oil, one in August and the other in September. Additional oil was produced and stored at the Bent Horn storage facility in preparation for the 1989 summer shipping season.

The drilling phase of the Norman Wells Expansion Project was completed in 1988. At year-end, a total of 310 wells were active, including 158 producers and 152 injectors. Production at Norman Wells increased to 1.728 million m^3 in 1988.

COGLA participated in an assessment of the hydrocarbon potential of the Mackenzie Delta - Beaufort Sea basin with the Institute of Sedimentary and Petroleum Geology in Calgary. As a result of the assessment, oil and gas resources in this basin were estimated at 1.13 billion m^3 of oil and 1.9 trillion m^3 of natural gas. These estimates are somewhat lower than those previously published.

In April the governments of Canada and Nova Scotia agreed to place a moratorium on exploration activity on Georges Bank off Nova Scotia until the year 2000. An independent panel will conduct a public review of the environmental and socio-economic impacts of oil and gas exploration and drilling on Georges Bank and will report its findings to the ministers of energy for Canada and Nova Scotia on or before 1 July 1999. The moratorium and public review requirements will be incorporated into law through the Canada - Nova Scotia Accord implementing legislation.

The Environmental Studies Management Board was established under the Canada Petroleum Resources Act to advise ministers on the operations of the Environmental Studies Research Funds. The 12 board members represent federal government departments, regional petroleum boards, the oil and gas industry, and the public.

Federal-Provincial-Territorial Management of the Frontier Lands

Prime Minister Brian Mulroney and Northwest Territories Government Leader Dennis Patterson at the signing of the agreement-in-principle on a Northern Accord in Yellowknife on 6 September 1988.

Offshore Accords

The federal government signed offshore accords with the Government of Newfoundland and Labrador in 1985, and with the Government of Nova Scotia in 1986. Under the accords, the provinces have an equal say with the Government of Canada in the legislation and regulation of offshore petroleum activities. The provinces also receive revenues from offshore petroleum activities and production as if the resources were on land.

The East Coast accords incorporate the provisions of the Canada Petroleum Resources Act and the Oil and Gas Production and Conservation Act. The regulations under each accord implementing legislation correspond closely to those in effect elsewhere on frontier lands. This ensures a consistent regulatory regime in all Canada's offshore areas.

Each accord establishes a new independent board to manage an offshore area on behalf of Canada and the province. The boards regulate offshore activities, although the federal and provincial energy ministers retain authority to review certain fundamental decisions.

Newfoundland and Labrador

The Canada-Newfoundland Offshore Petroleum Board (CNOPB) has formally regulated petroleum activities in the Newfoundland offshore since 4 April 1987, the day the Atlantic Accord implementation legislation was proclaimed. Located in St. John's, Newfoundland, CNOPB publishes its own annual report covering offshore operations during its fiscal year, which ends 31 March.

Through memorandums of understanding, CNOPB coordinates its activities with federal and provincial departments that have a mandate in the offshore. In 1988 memorandums on environmental services, fisheries and ocean-related matters were signed. In November the board conducted its first issuance of new exploration rights under the Canada-Newfoundland Atlantic Accord Implementation Act, awarding exploration licences for two parcels in the vicinity of Hibernia.

In July 1988 the governments of Canada and of Newfoundland and Labrador signed a statement of principles with Mobil and its partners to develop the Hibernia field. Production is scheduled to begin in 1995. As Canada's first commercial offshore oil project on the East Coast, Hibernia will be an important milestone in the history of frontier oil and gas development in Canada.

Nova Scotia

The Government of Canada passed legislation to implement the Canada - Nova Scotia Offshore Petroleum Accord in July 1988. Matching provincial legislation was passed by the Nova Scotia legislature earlier in the year. Both the federal and provincial governments are expected to proclaim the accord implementation legislation in 1989. A new independent board will then assume legal responsibility for managing the offshore on proclamation date.

The existing Canada - Nova Scotia Offshore Oil and Gas Board, established in 1982, continued to regulate the offshore area throughout 1988. Maurice Taschereau, COGLA's administrator, chairs the board. Board decisions and operations fully reflect the joint management principles of the 1986 accord. The current board will carry out its duties until the accord legislation is proclaimed and the new offshore petroleum board assumes responsibility.

Mobil drilled one well, and Shell conducted one well-site seabed survey off Nova Scotia in 1988. As well, Mobil carried out final abandonment and removal of all seafloor material at four of its former drilling sites in the area. Low oil prices have dramatically affected activity in the Nova Scotia offshore; no rigs were active at year-end and industry drilling plans for 1989 remain uncertain.

British Columbia

In 1988 the governments of Canada and British Columbia continued discussions on a Pacific Accord. The prohibitions on offshore petroleum activity, in place since the early 1970s, remained in effect throughout the year. The federal and provincial governments cooperated in following up on many of the recommendations in the *West Coast Offshore Exploration Environmental Assessment Panel Report*. Following its review and extensive public hearings, the panel found that oil and gas exploration could resume safely in the offshore area under stringent conditions and procedures. Most of the report's recommendations were accepted. In October 1988 a progress report on the governments' follow-up work was released.

Northern Accord

In September 1988 the governments of Yukon and the Northwest Territories signed agreements with the Government of Canada on the negotiating principles for a Northern Accord.

The Government of Canada has agreed in principle to negotiate agreements to transfer to the territorial governments the administrative and legislative powers to manage oil and gas resources in the northern onshore area. The agreements in principle also provide for negotiating joint management of the offshore areas in the North. Until the transfer of management is completed, the federal government will consult the territorial governments fully on regulatory decisions.

COGLA's Role in Joint Management

COGLA cooperates closely with the coastal provinces and the territorial governments in carrying out its responsibilities. COGLA plays a lead role in implementing accords by facilitating the transfer of regulatory and management responsibilities, and maintains advisory and coordinating functions after the accords are fully implemented. In geographic areas where accords have not been concluded and passed into law, COGLA manages and regulates offshore petroleum activity in keeping with the joint management principles established in the 1985 Frontier Energy Policy.

Rights Management

COGLA issues, manages, transfers and registers oil and gas exploration and production rights in Canada's North and offshore frontier areas not covered by regional boards, under the authority of the ministers of Indian Affairs and Northern Development, and of Energy, Mines and Resources. COGLA also administers certain federal mineral rights within the provinces on behalf of the Minister of Energy, Mines and Resources.

Frontier Lands

During 1988 COGLA completed work on second terms for those exploration licences in which the initial term had expired. COGLA also developed and implemented forms for the three new types of licences established under the Canada Petroleum Resources Act (CPRA), namely exploration, significant discovery and production licences. The exploration licence replaces the exploration agreement. Twelve exploration licences and one exploration agreement were issued in 1988, providing the interest owners with a second term (generally for four years) to carry out exploration activity. The first year of the second term is rent free, but rentals apply on an increasing scale every year thereafter. Such rentals may be refunded commensurate with allowable expenditures incurred through exploratory work on the lands.

There were 92 significant discovery licences issued in 1988, providing a new title document to holders of rights in areas subject to significant discovery area declarations. As well as maintaining exclusive rights to drill on and to develop the lands to produce petroleum, these licences preserve an interest owner's right to obtain a production licence. Significant discovery licences remain in force as long as the relevant declaration of significant discovery is in force, or until a production licence is issued.

At year-end, the industry held 7.1 million hectares of frontier lands, consisting of 59 exploration agreements and licences, 92 significant discovery licences and 2 production licences. In addition, about 18.5 million hectares are held in areas where exploration is not allowed.

In 1988 Part VIII of CPRA, concerning transfers, assignments and registration, came into effect. On 28 April the Frontier Lands Registration Regulations were enacted, and COGLA set up a public register of petroleum exploration and production interests and instruments. The registration system records the ownership of interests such as exploration licences, significant discovery licences and production licences, as well as certain former exploration agreements, former leases, former permits and claims related to these existing rights. For a fee, the public can review an interest and related documents. A registrar and deputy registrar were appointed within COGLA to perform the registration duties. Since the registry opened, 364 interests and 108 instruments have been registered. This registration system does not include interests held offshore Newfoundland and Labrador.

The Canada-Newfoundland Offshore Petroleum Board (CNOPB) established an identical public register for interests held offshore Newfoundland and Labrador. The Newfoundland Offshore Area Registration Regulations set up the Newfoundland public register on 25 May.

CNOPB issued two licences offshore Newfoundland following a call for bids that closed in September. At year-end CNOPB administered rights held under 9 exploration licences and 10 significant discovery licences.

No new rights were issued in the North or in the Nova Scotia offshore.

At the end of the year, the Canada - Nova Scotia Offshore Oil and Gas Board administered rights held under 15 exploration agreements, which include 19 declared significant discovery areas. In the Georges Bank area a prohibition on exploration was announced until the year 2000.

The Frontier Lands Petroleum Royalty Regulations 1987 were promulgated to provide an interim regime for the payment of frontier royalties. They were also extended at year-end to apply until December 1990. These interim regulations will continue to be in force until more comprehensive regulations, now under development, are enacted.

In 1988 COGLA consulted with industry, the accord provinces, the offshore boards and territorial governments to develop regulations under CPRA on royalties and Canadian ownership, together with guidelines, forms and procedures for surveys.

As well, information on existing rights and the rights issuance process was provided to companies, native groups, land use planning commissions in the North and other interested parties.

Public Lands

In response to requests from industry, tenders were solicited for 125 parcels of oil and gas leasehold rights, located mainly in the western provinces. In October tenders were accepted for 59 parcels, bringing in more than $1 million in cash bonus revenues.

FRONTIER LAND HOLDINGS AT YEAR-END, 1988	1984	1985	1986	1987	1988
Number of Licences/Agreements Active*	153	150	118	112	153
Lands Negotiated into Licences/Agreements (millions of ha)	21.2	24.9	4.1	7.3	2.31
Lands Relinquished or Surrendered (millions of ha)	24.7	20.0	39.2	15.1	16.5
Lands Active (millions of ha)	89.5	70.8	33.5	20.6	7.1

** Includes exploration licences, exploration agreements, significant discovery licences and production licences.*

LAND STATUS AT YEAR-END, 1988

	Active Licences/ Agreements*	Lands Relinquished or Surrendered	Lands Negotiated into Licences/ Agreements	Lands Active	Pending Lands**
		(millions of ha)	(millions of ha)	(millions of ha)	(millions of ha)
Mainland Territories	30	0.9	0.08	1.2	1.1
Mackenzie Delta and Beaufort Sea	59	2.1	1.4	3.4	0
Arctic Islands and Eastern Arctic Offshore	30	0.6	0.4	1.4	2.4
Hudson Bay	0	11.5	0.3	0	1.4
Grand Banks and Labrador Sea	19	1.0	0.1	0.8	1.5
Nova Scotia Offshore (includes Gulf of St. Lawrence)	15	0.4	0.03	0.3	3.4
West Coast	0	0	0	0	8.7
Total	153	16.5	2.31	7.1	18.5

** Includes exploration licences, exploration agreements, significant discovery licences and production licences.*

*** 'Pending' includes areas where exploration activity has been suspended: West Coast, Baffin Bay, Georges Bank, St. Pierre and Miquelon, etc.*

Rights Management

LICENCES/AGREEMENTS NEGOTIATED IN 1988

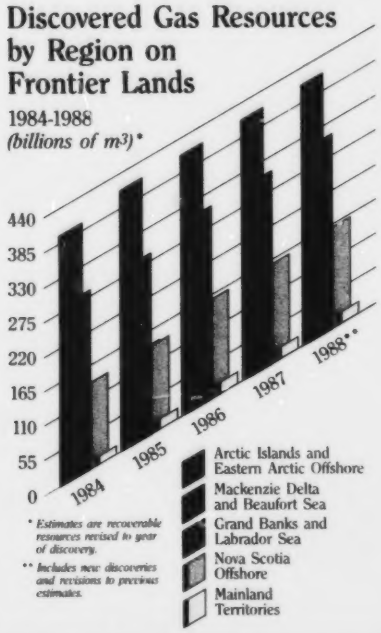
Operating Company	Licence/ Agreement	Number of Licences/ Agreements*	Area (thousands of ha)	Location	Term (years)
Esso	EL 340-345	6	1 073	Mackenzie Delta/Beaufort Sea	4
Dome	EL 346	1	199	Beaufort Sea	4
Panarctic	EL 347	1	64	Cameron Island	4
Can. Southern	EL 348	1	30	Cameron Island	4
Sogepet	EL 349	1	352	Hudson Bay	4
Canterra	EA 350	1	36	South Sable	3
Amoco	SDL 001-004	4	3	Mackenzie Valley	—
Canterra	SDL 005	1	11	Eastern Arctic	—
Dome	SDL 006	1	7	Mackenzie Valley	—
Paramount	SDL 007-010	4	6	Mackenzie Valley	—
Phillips	SDL 011	1	3	Mackenzie Valley	—
PanCanadian	SDL 012	1	13	Mackenzie Valley	—
Suncor	SDL 013	1	5	Mackenzie Valley	—
Chevron	SDL 014-016	3	2	Mackenzie Delta	—
Shell	SDL 017-019	3	8	Mackenzie Delta	—
Westmin	SDL 020-022	3	12	Yukon	—
Petro-Canada	SDL 023-024	2	29	Mackenzie Valley	—
Suncor	SDL 025-028	4	4	Mackenzie Delta	—
Gulf	SDL 029-036	8	44	Mackenzie Delta	—
Provo Gas	SDL 037	1	8	Beaufort Sea	—
Dome	SDL 038	1	6	Beaufort Sea	—
113967 Ontario	SDL 039	1	12	Beaufort Sea	—
Dome	SDL 040-041	2	15	Beaufort Sea	—
Dome	SDL 042	1	2	Mackenzie Valley	—
Panarctic	SDL 043-046	4	23	Arctic Islands	—
Placid Northern	SDL 047-049	3	13	Beaufort Sea	—
Esso	SDL 050-065	16	65	Mackenzie Delta/Beaufort Sea	—
Dome	SDL 066	1	3	Arctic Islands	—
Panarctic	SDL 067-081	15	306	Arctic Islands	—
Dome	SDL 082	1	14	Eastern Arctic	—
Petro-Canada	SDL 184, 185A&B, 187	4	25	CNOPB	—
Mobil	SDL 195-197, 200	4	37	CNOPB	—
Canterra	SDL 203	1	2	CNOPB	—
Petro-Canada	SDL 208	1	4	CNOPB	—
Petro-Canada	EL 1001	1	54	CNOPB	6
BP Resources	EL 1002	1	58	CNOPB	6

** Includes exploration licences and significant discovery licences.*

Exploration Activity

Discovered Gas Resources by Region on Frontier Lands

1984-1988
*(billions of m³)**

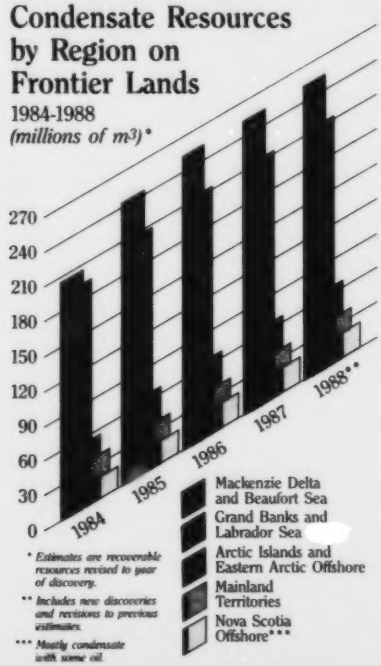


* *Estimates are recoverable resources revised to year of discovery.*

** *Includes new discoveries and revisions to previous estimates.*

Discovered Oil and Condensate Resources by Region on Frontier Lands

1984-1988
*(millions of m³)**



* *Estimates are recoverable resources revised to year of discovery.*

** *Includes new discoveries and revisions to previous estimates.*

*** *Mostly condensate with some oil.*

A total of 18 delineation and exploratory wells were active on frontier lands this year. This is a slight increase over last year and halts the recent trend of decreasing drilling activity. Sixteen wells were terminated in 1988, seven in the North and nine on the East Coast offshore. At year-end drilling was under way at one location offshore Newfoundland. Of the 18 wells active in 1988, 8 were delineation wells. This indicates industry's interest in confirming reserves in known discoveries to prepare for eventual production. Of the delineation wells, six contained hydrocarbons. Hydrocarbons were also discovered in two of the ten exploratory wells (Gulf et al Amauligak O-86 and Mobil et al South Sable B-44).

Geophysical activity increased noticeably from last year, with a trend toward three-dimensional or site-specific surveys. This again reflects industry's interest in proving up future drilling locations.

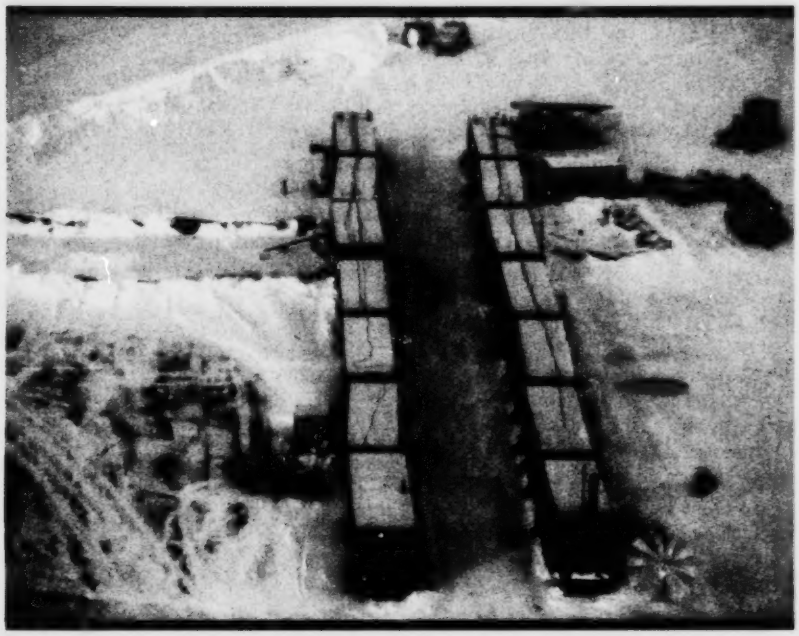
The North

The continued success of both exploratory and delineation drilling in the Amauligak area of the Beaufort Sea highlighted northern exploration.

Beaufort Sea and Mackenzie Delta

The Beaufort Sea continued to be the most important area for exploration activity in the North. Several companies conducted geophysical or geological programs this year. Esso completed three seismic programs, two onshore (including a three-dimensional survey at Taglu) and one offshore. Amoco concluded a regional seismic program, conducted several site-specific high-resolution surveys in the west Beaufort and undertook a large airborne geochemical survey over most of the Beaufort. Geophysical Services Inc. carried out a three-dimensional seismic survey in the offshore, and Gulf did a small electromagnetic survey over a potential pipeline route to Amauligak.

Exploration Activity



Drilling camp for Esso's three-dimensional seismic project at Taglu on the east side of the Mackenzie Delta.
Courtesy, L. Richards.

Four delineation wells and one exploratory well were active in 1988. The delineation wells were all drilled from the east berm location at the Amauligak discovery. Gulf et al Amauligak 2F-24, which began drilling in late 1987, was deviated to the southwest and abandoned without being tested in early 1988. The operator then drilled Gulf et al Amauligak 2F-24A to a location north of 2F-24 and encountered the gas-bearing pay zone in a structurally higher position. Gulf et al Amauligak F-24, which had been drilled to total depth in 1987, was then tested; it flowed oil from several zones at rates up to 1096 m^3 per day. After this well was abandoned, Amauligak 2F-24B was drilled from the 2F-24 well-bore and then deviated to the northeast of the berm. The operator then tested the well and encountered oil from several zones at rates up to 950 m^3 per day.

Only one exploratory well, Gulf et al Amauligak O-86, was drilled at a location just west of the Amauligak field, using the *Kulluk* floating drilling unit. The operator tested the well and discovered hydrocarbons in a fault block completely separated from the main Amauligak discovery and the 1986 West Amauligak oil discovery. The discovery contained oil and gas and, when tested, flowed oil at a rate of up to 1059 m^3 per day.

Mainland Territories

Several companies conducted exploration activities on the Mainland Territories during 1988. Chevron undertook a seismic survey, a geological field survey and an extensive gravity survey in the Fort Good Hope, N.W.T. area. Mobil carried out a small three-dimensional seismic survey in the same area. Both Shell and Petro-Canada conducted seismic surveys in the southern Northwest Territories. Northcor completed a large aeromagnetic survey along the southern border of the Northwest Territories.

Three exploratory wells were also drilled this year. Conoco et al East MacKay I-55 and Conoco et al North Little Bear L-21, located south of Norman Wells, were both abandoned without testing. After disappointing results, the Shell et al Arrowhead 2B-76 well was also abandoned without testing.

Arctic Islands

No geological, geophysical or drilling activity took place in the Arctic Islands in 1988.

East Coast Offshore

East Coast offshore 1988 highlights included the successful delineation drilling at Terra Nova and Whiterose in the Jeanne d'Arc Basin off Newfoundland, and Mobil's gas discovery south of Sable Island.

Newfoundland Offshore

Several companies were involved in geophysical exploration in the Newfoundland offshore this year. All activity was confined to the Jeanne d'Arc Basin except for an airborne geochemical survey conducted by Amoco over a wide area. Chevron and Petro-Canada conducted seismic surveys, and Texaco and Petro-Canada each carried out high-resolution well-site surveys.

The Newfoundland offshore was the most active drilling area on frontier lands, with four delineation wells and five exploratory wells. Husky drilled two delineation wells within the Whiterose significant discovery area. Hydrocarbons were discovered in the primary objective at Husky/Bow Valley et al Whiterose E-09 and, when tested, flowed oil and gas at high rates. The second well, Husky/Bow Valley et al Whiterose A-90 located about 4 km to the east, did not find the primary reservoir section and the operator abandoned the well without testing.

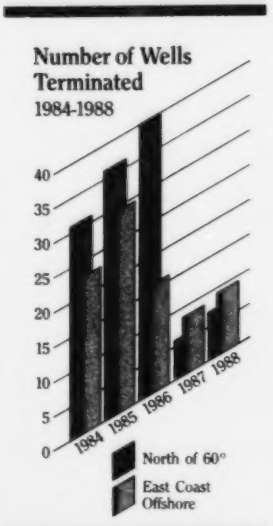
Petro-Canada continued its success in the Terra Nova area, drilling and testing two more delineation wells. The Petro-Canada et al Terra Nova C-09 well, in the central portion of the structure, encountered a good oil-bearing reservoir and flowed oil at rates up to 1155 m^3 per day. The Terra Nova E-79 well, on the east flank of the structure, also found a thick reservoir section that flowed oil at rates up to 1400 m^3 per day.

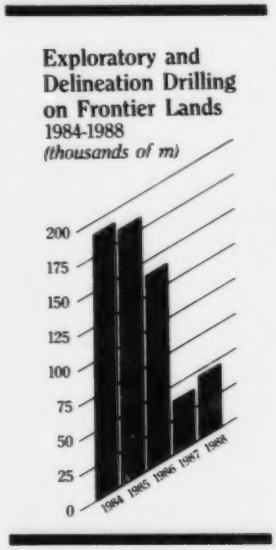
Exploratory drilling was not as successful as in previous years. Mobil et al Avondale A-46 was dry and abandoned. Petro-Canada et al South Brook N-30, located south of Terra Nova, and Chevron et al East Rankin H-21, located south of Hibernia, were also dry and abandoned, but shows of heavy oil were reported. Texaco and partners commenced a three-well drilling program under the terms of a farm-out agreement with Husky and associates. The first well, Texaco et al South Merasheen K-55, was dry and abandoned without testing. The second wildcat well, Texaco et al Amethyst F-20, was spudded in late December and was drilling at year-end.

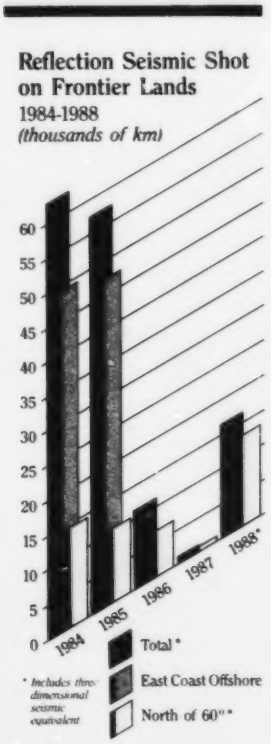
Nova Scotia Offshore

Geophysical activity was minimal during 1988; Mobil did a small side scan sonar study and Shell conducted one well-site survey.

In 1988 one exploratory well, Mobil et al South Sable B-44, was drilled south of Sable Island and tested gas at rates up to 594 881 m^3 per day. South Sable B-44 will be the twenty-second significant discovery in the Nova Scotia offshore.







Resource Evaluation Activities

Many of COGLA's resource management responsibilities rely on a sound understanding of the petroleum geology, geophysics and hydrocarbon potential of the frontier lands.

Analysis of Hydrocarbon Potential

COGLA conducts a variety of assessments to evaluate the hydrocarbon resources of Canada's frontier lands. These assessments range from regional projects over entire basins to smaller areas within regions, such as areas proposed for national park reserves.

In 1988 COGLA and the Institute of Sedimentary and Petroleum Geology of Calgary completed a hydrocarbon assessment of the Mackenzie Delta - Beaufort Sea basin. The assessment estimated potential oil and gas resources under the Beaufort Sea and the Mackenzie River basin at 1.13 billion m^3 of oil and 1.9 trillion m^3 of natural gas. These estimates are somewhat lower than those previously published.

During 1988 COGLA completed geological assessments of hydrocarbon prospectivity for a proposed national park on Banks Island and for proposed national marine parks in Lancaster Sound and the offshore area surrounding South Moresby Island in the West Coast offshore. COGLA also examined background information and compiled data on a proposed extension of the Nahanni National Park Reserve in the southern Northwest Territories. As well, COGLA assessed resources within the new Grasslands National Park in Saskatchewan.

For the several land use planning exercises, COGLA's geologists contributed important technical information and analysis of hydrocarbon prospectivity. In 1988 this work focused on the Lancaster Sound Regional Land Use Planning Commission, and preparatory work was initiated for the Beaufort Sea - Mackenzie Delta and Mackenzie Valley land use planning exercises.

Research

COGLA participated with the Canada Centre for Remote Sensing (RADARSAT Project) in a study to evaluate the merits of synthetic aperture radar (SAR) surveys for mapping subsurface geological structures and trends in the southern Northwest Territories. This work resulted in an experimental SAR survey over an area in the southern Northwest Territories near Fort Liard where subsurface structural trends are already well known.

COGLA collaborated with the National Research Council and Teknica Resource Development of Calgary on technical issues for the Tekxpert project designed to develop an interactive workstation for processing and interpreting seismic and well information using artificial intelligence. COGLA reviewed the project and recommended continued partial financial support under the Industrial Research Assistance Program.

COGLA initiated a joint industry-government committee to examine the influence of oil-based drilling muds on geochemical evaluation of well cuttings and cores. As a result, a research project was initiated with the objective to further define the problem and investigate solutions. This research program is now in progress under contract to Geofuels Inc. of Sydney, Nova Scotia, and is being funded under the Program for Energy Research and Development.

Conservation and Development

COGLA regulates the development and production of oil and gas on frontier lands and ensures effective conservation of these valuable, nonrenewable resources. Reservoir engineering studies provide the basis for effective regulation and control.

Mainland Territories

Norman Wells

COGLA continued to monitor the Norman Wells waterflood project. Positive trends established by the waterflood expansion continued — the oil rate and reservoir pressure increased and the gas-oil ratio decreased.

COGLA developed a production database for all Norman Wells production and injection wells with historical data starting in 1982. The database is updated monthly and cumulative production data is available for all wells.

Oil production from the Norman Wells field in 1988 totaled 1.728 million m^3, an increase from 1.531 million m^3 in 1987. The daily average oil production rate was 4721 m^3 per day. Cumulative oil production to 31 December was 9.267 million m^3

Gas production in 1988 decreased to 138 million m^3 from 163 million m^3 in 1987.

There were 11 additional wells drilled in 1988, increasing the well count to 158 producers and 152 injectors.

Pointed Mountain

Gas production from the Pointed Mountain gas field continued to decline in 1988. Annual production decreased by 2 million m^3 from 156 million in 1987 to 154 million. Cumulative gas production to year-end totaled 7.985 billion m^3.

Beaufort Sea

Mackenzie Delta - Beaufort Sea Gas

This year Esso and Shell submitted applications for export licences to the National Energy Board to produce and export gas from discoveries in the Mackenzie Delta and Beaufort Sea region. The applications represent the first phase of a regulatory approval process that could lead to the development of an estimated 302.9 billion m^3 of discovered gas reserves.

At year-end COGLA was reviewing gas reserve estimates and production capabilities for all Mackenzie Delta - Beaufort Sea gas discoveries. COGLA also finished a detailed geological and engineering study of the Taglu field, including full two-dimensional and three-dimensional computer simulation studies. Plans were under way to conduct similar studies on other significant fields such as Niglintgak, Parsons Lake, Amauligak and Issungnak.

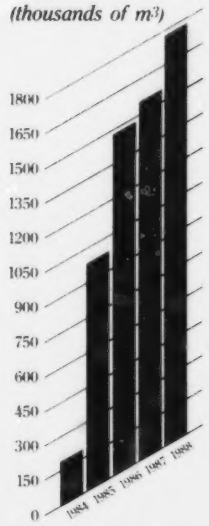
Amauligak

Gulf completed the delineation drilling program at the Amauligak F-24 berm site on the east side of the Amauligak structure. The F-24 and 2F-24B wells encountered significant oil and gas zones; they flowed at test-rates up to 1096 m^3 of oil per day, and gas rates up to 670 000 m^3 per day.

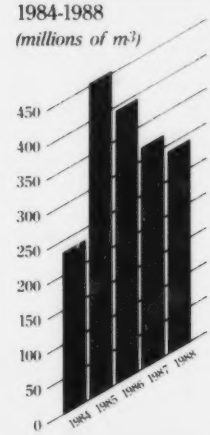
This drilling program completed the delineation phase for the Amauligak structure, resulting in six delineation wells following the 1984 Amauligak J-44 discovery. It is estimated that the field contains more than 79.5 million m^3 of recoverable oil.

The operator and COGLA are now analyzing all data, including seismic data, well logs, cores, fluid analyses, drillstem test results and production test results. A comprehensive review of the geology and reservoir engineering aspects of the field will be prepared. The review will evaluate reserves, development systems, development-well drilling, production alternatives and production rates to maximize resource conservation.

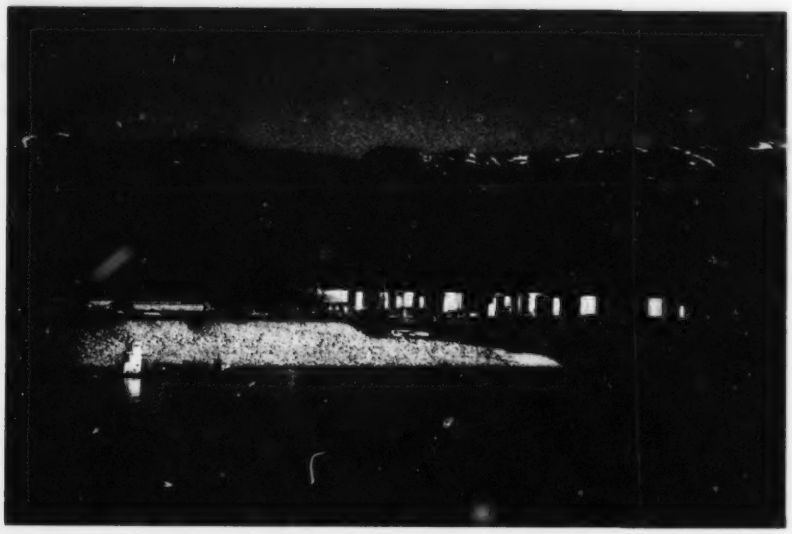
Oil Production on Frontier Lands
1984-1988
(thousands of m^3)



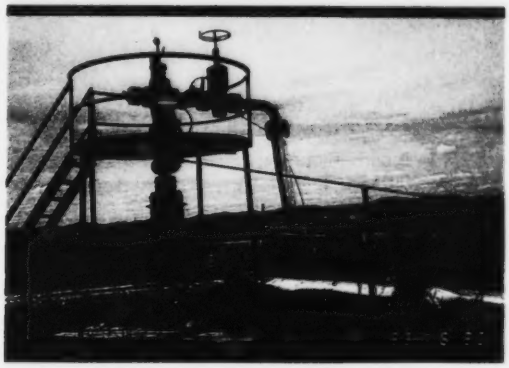
Gas Production on Frontier Lands
1984-1988
(millions of m^3)



Conservation and Development



Norman Wells production facility. Courtesy, B. Moore.



A gas producing well at Pointed Mountain in the southern Northwest Territories. Courtesy, W.F. Neeser.

Arctic Islands

Bent Horn

For the fourth year in a row, Panarctic undertook seasonal production at the Bent Horn oil field on Cameron Island and shipped oil to southern markets by tanker. The first shipment of 23 761 m^3 left Bent Horn on 12 August on the *MV Arctic*. About 1700 m^3 was dropped off at Resolute for the Northwest Territories Power Corporation. The *MV Arctic* picked up the second oil shipment (23 200 m^3) on 4 September. After this shipment, more oil was produced and stored in the Bent Horn storage facilities to prepare for the next summer's shipping season. A total of 54 894 m^3 of oil was produced from the Bent Horn field during 1988.

Newfoundland Offshore

Terra Nova Oil Field

The preliminary delineation program for the Terra Nova structure was completed in 1988 with the completion of the Terra Nova C-09 and Terra Nova E-79 wells. These highly successful wells extended the known limits of the excellent quality reservoir in the structure. Both wells flowed oil on test programs with rates as high as 1400 m^3 per day.

This brings to seven the total number of delineation wells drilled following the 1984 Terra Nova K-08 discovery. The operator, Petro-Canada, announced it is undertaking an engineering feasibility study of alternative methods of development and expects to decide on a development plan application by September 1989.

Hibernia

Two reports on the Hibernia oil field were completed: Volume I presents the geology, reservoir data analysis and volumetric reserve calculations; and Volume II contains the results of the reservoir simulation study. COGLA presented the results of these studies to the Canada-Newfoundland Offshore Petroleum Board at its request. The studies provide estimates of oil recovery and production rates for the Hibernia field.

Protection of the Worker

During 1988 COGLA worked closely with the federal departments of Energy, Mines and Resources and Indian Affairs and Northern Development; the accord provinces; British Columbia; the Northwest Territories; Yukon; and the Canada-Newfoundland Offshore Petroleum Board (CNOPB) to finalize proposals for safety and technical amendments to the Oil and Gas Production and Conservation Act (OGPCA) and corresponding sections of the implementation legislation for the Atlantic and Canada - Nova Scotia accords. As part of this work, COGLA chaired two meetings with the Canadian Petroleum Association to discuss industry's views on the proposals. Toward the end of the year COGLA began work on the amendment drafting instructions for the Department of Justice.

Occupational Safety and Health

Under a memorandum of understanding (MOU) with Labour Canada, COGLA promotes the safety and health of workers involved in the exploration, production, processing, conservation or transportation of oil and gas in the frontier areas. This is stipulated in Part IV of the Canada Labour Code and the Oil and Gas Occupational Safety and Health Regulations. The code sets out workers' basic rights and promotes voluntary cooperation between employers and employees to solve safety and health concerns in the workplace. All workplaces must now have safety and health committees or representatives. The Minister of Labour appointed COGLA engineers and inspectors as safety officers to check the safety and health of personnel working at petroleum exploration and production sites.

In 1988 the Oil and Gas Occupational Safety and Health Regulations were amended to incorporate the Workplace Hazardous Materials Information System (WHMIS). WHMIS is a national system that provides information on hazardous materials used in the workplace. The system stresses the importance of carefully labeling containers of hazardous materials and providing material safety data sheets and educational programs for workers.

Survival suit being tested during development of survival suit standards.

COGLA has also been involved in the drafting of occupational safety and health regulations for the Newfoundland offshore. COGLA and the Newfoundland Department of Energy drafted the Petroleum Occupational Safety and Health Regulations, Offshore Newfoundland, with help from CNOPB, the Nova Scotia Department of Mines and Energy, Labour Canada and the Newfoundland Department of Labour. To ensure consistent safety and health standards on all frontier lands, an MOU between relevant federal and provincial agencies was drawn up. The MOU would make CNOPB responsible for administering all occupational safety and health legislation for oil and gas workers in the Newfoundland offshore.

Drilling

Amendments to the Canada Oil and Gas Drilling Regulations came into effect in September. Some of the amendments respond to the requirements of the Statutory Instruments Committee and were developed through correspondence with the committee over several years. The rest were 'housekeeping' amendments covering updates of codes and standards referred to in the regulations, and minor changes for consistency with other regulations in force.

Protection of the Worker

H_2S facility at the PITS Nisku Training Centre. Courtesy, Petroleum Industry Training Service.

In 1988 representatives of COGLA, the Newfoundland Department of Energy, the Nova Scotia Department of Mines and Energy, and CNOPB formed a committee to revise the Drilling Regulations. The revision will update the technical aspects to ensure that only the best and safest practices are used in the frontier areas. In addition, it will remove those occupational safety and health provisions that were included in the regulations under the Canada Labour Code. The committee expects to have a draft of these new drilling regulations available for industry review in early 1989.

Production

The petroleum industry and the classification societies reviewed a draft of the Production Installation Regulations that covers technical requirements for designing, constructing, installing, operating and maintaining a production installation. The regulations include requirements for a safety analysis to ensure the continuing safety of workers and the protection of the environment throughout the life of a production installation.

COGLA drafted development plan guidelines to help operators comply with OGPCA when seeking the minister's approval for development projects. The guidelines describe the information needed for a development plan application. They also discuss the requirements for a project's environmental and socioeconomic impact statement, environmental protection plan, contingency plans, waste treatment, effects monitoring and mitigative strategies.

COGLA drafted regulations for the design, construction and operation of offshore pipelines. The regulations will help to protect pipeline workers and the environment. The draft is now being discussed with provincial, territorial and federal government departments and regional boards concerned with regulating offshore pipelines. COGLA will consult industry on the draft in 1989.

Geophysical

The petroleum industry, provincial, territorial and federal government departments, and CNOPB reviewed drafts of the Canada Oil and Gas Geophysical Regulations and the Newfoundland Offshore Area Oil and Gas Geophysical Regulations. At year-end the regulations were being prepared for publication in the *Canada Gazette*.

Diving

The Canada Oil and Gas Diving Regulations and the Newfoundland Offshore Area Petroleum Diving Regulations came into effect in December. These regulations prescribe minimum training requirements and experience for divers and dive-related personnel. In addition, they address the technical and safety aspects of diving equipment as well as the various types of diving operations.

Marine

In 1988 COGLA and the Canadian Coast Guard (CCG) formed regional technical committees to deal with issues concerning standby vessels used to support drilling units. The committees will look into any variations from the standards requested by operators with a view to the granting of equivalencies.

Also in 1988 the national COGLA/CCG Technical Committee made several changes to the Standards Respecting Standby Vessels. These changes resulted from recommendations by owners, operators and marine surveyors. The most significant change was to allow the carriage on deck of a limited amount and type of cargo while the vessel was on standby duty.

Safety Advisory Committee

COGLA, along with the Canadian Petroleum Association, chairs the Frontier Lands Safety Advisory Committee. This committee reviews all new regulatory initiatives with a view to promoting the safety of industry workers. It draws its membership from offshore boards, Department of Health and Welfare, CCG and industry associations to ensure that the best technical and managerial advice is applied to matters of safety.

Standards for Survival Suit Systems

COGLA chairs the committee responsible for developing survival suit standards. In 1988 the Survival Suits Committee drafted the marine abandonment survival suit standard and the working suit standard. These standards set out design and performance criteria for survival suit and working suit systems. The Canadian General Standards Board is expected to publish both standards in 1989. Once they are published, operators will have a reasonable amount of time to comply with the standards.

LOST-TIME ACCIDENTS ON FRONTIER LANDS, 1988

	Person-Hours at Work Site		Lost-Time Accidents		Accident Rate	
	Drilling Unit	Standby/ Supply Vessel	Drilling Unit	Standby/ Supply Vessel	Drilling Unit	Standby/ Supply Vessel
					(LTA/Millions of Person-Hours)	
Mainland Territories	81 464	N/A	2	N/A	24.5	N/A
Mackenzie Delta and Beaufort Sea	957 290	344 592	9	1	9.4	2.9
Arctic Islands and Eastern Arctic Offshore	N/A	N/A	N/A	N/A	N/A	N/A
Grand Banks and Labrador Sea	482 402	197 184	11	7	22.8	35.5
Nova Scotia Offshore*	65 428	42 744	2	1	30.6	23.4
Total	1 586 584	584 520	24	9		

* *Estimated*.

Canadian Standards Association – Offshore Code

COGLA serves on the Canadian Standards Association (CSA) Steering Committee on Offshore Structures and its five technical committees, which were set up in 1984 to develop a code for the design, construction and installation of fixed offshore structures. Preliminary standards for design criteria and loads, foundations, steel structures, concrete structures and sea operations were published in 1988. COGLA and CSA have set up a program to verify the code's technical and practical aspects. This program will involve reviewing and commenting on the preliminary standards and carefully checking the standards' technical requirements.

Safety Training

In 1988 COGLA served on a technical committee that developed a training program to protect workers from deadly hydrogen sulphide (H_2S) gas, which is commonly associated with oil and gas in the subsurface. The committee included representatives from industry and the western provinces. The program consists of three progressively more detailed courses: H_2S Alive, H_2S Rescue and H_2S Instructor. Oil field staff working in H_2S areas are now required to take the course that corresponds to their duties.

COGLA worked with CCG to draft certification and manning regulations for the training and qualifications of technical and supervisory staff employed on mobile offshore drilling units or production vessels. When they come into force in 1989, these regulations will require all senior staff to have the appropriate oil field and marine qualifications for their position.

Inspections

As part of its mandate, COGLA carries out periodic inspections at exploration or production sites to assess the safety and effectiveness of the operation and to ensure compliance with regulations. In 1988 COGLA officers conducted 26 drilling and 6 production facilities inspections on the frontier lands.

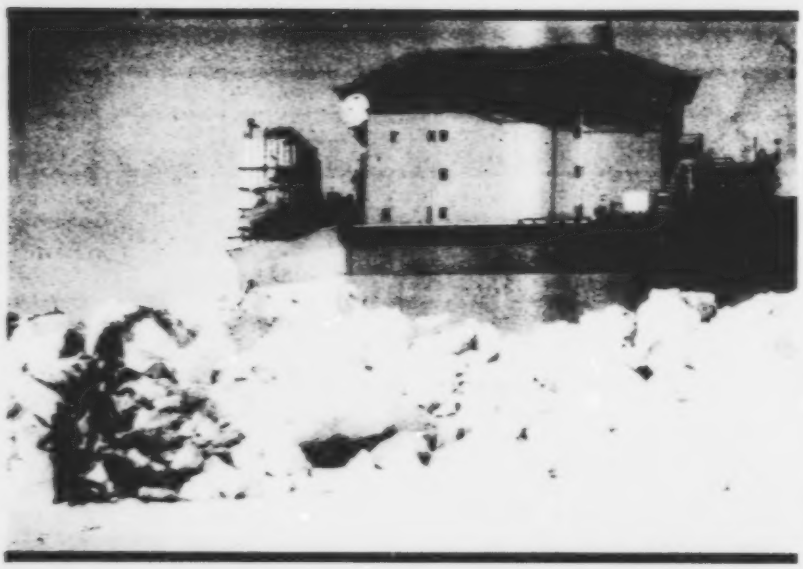
Lost-Time Accidents

The accident rate for drilling operations, calculated as the number of lost-time accidents (LTAs) per million person-hours worked, increased in 1988 to 15.1 (compared with 9.7 in 1987). There were no production-related LTAs reported on the frontier lands in 1988. However, 11 lost-time accidents occurred while conducting geophysical operations. There were no fatalities associated with oil and gas exploration or production in 1988.

Physical Environmental Monitoring

As in the past three years, ice conditions over the Beaufort were very favorable for drilling. Pack ice moved from the Amauligak drilling area earlier than usual, permitting the *Kulluk* to begin operating two weeks ahead of schedule. Ice conditions remained very good throughout the summer drilling season with no hazardous ice reported within 40 nautical miles (76 km) of the drilling area.

Protection of the Worker



Ice rubble field formation as a result of ice and structure interaction. Courtesy, Gulf Canada Resources Ltd.

The *Bow Drill 3* and the *Sedco 710* operated on the Grand Banks during the 1987-88 pack ice season. Because of encroaching ice, the *Bow Drill 3* moved to Marystown from 29 February to 18 April. The *Sedco 710* also moved there from 31 March to 12 April. Although several icebergs moved over the northern Grand Banks, there were fewer than usual. Those that threatened drilling operations were successfully towed from the drilling units.

Research and Development

The Panel for Energy Research and Development (PERD) promotes the development of technical knowledge to help the federal government fulfil its responsibilities for supplying and managing crude oil, natural gas and electrical resources. Under PERD, COGLA chairs the Marine Engineering Committee and promotes studies on the construction of offshore structures, the interaction between ice and offshore structures, diving and evacuation technology, and environmental design criteria. Several research projects to resolve design and construction problems associated with frontier oil and gas activities in Canada were initiated during the year. The major projects managed by COGLA are described below.

Protection of Submarine Pipelines from Ice Scour

The goal of this project is to determine the extent to which ice scouring can threaten the integrity of offshore pipelines in the Beaufort Sea. In 1988 this project examined the effects of ice scour on the soils surrounding a buried submarine pipeline. The consultants compiled ice scour data representing typical conditions in the Beaufort Sea. The results will be entered into a computer program to determine the soil movement and other effects of ice scour on submarine pipelines.

Fill Retention Structures

COGLA worked with the petroleum industry to develop reliable methods for analyzing soil retention structures, such as caisson-retained drilling platforms, that are subject to cyclic loading pressures caused by ice movement. COGLA and the University of Ottawa organized a workshop of international experts and designers to examine various soil models used to describe the constitutive behavior of soils under cyclic loading.

These models were used in a study with the Atlantic Geoscience Centre and the United States National Science Foundation. The study concerned a caisson structure used in the Beaufort Sea. The results showed that the design method used for earthquake loading on land structures was not appropriate for ice loads in the Canadian offshore.

Ice-Structure Interaction

Among the several projects coordinated by a committee co-chaired by COGLA and Public Works Canada is one sponsored by COGLA that involves collecting data on the interaction between ice and fixed artificial structures. In 1988 this project examined the global and local ice loads experienced by the *Molikpaq* structure.

Evacuation Technology

In May 1988 COGLA conducted a safety technology workshop in St. John's, Newfoundland to establish research and development priorities for emergency equipment and sea-rescue techniques. Because helicopters are the preferred method for evacuating mobile offshore drilling units and are used in routine crew changes, the workshop concentrated on research priorities for all safety aspects of offshore helicopter operations.

In cooperation with industry, COGLA plays a leading role in the promotion of helicopter safety in the offshore. It is funding a study on how to exit safely from a helicopter downed in the water. At the same time, the Canadian Petroleum Association has commissioned a review of all documented relevant incidents of downed helicopters. Under a PERD contract, studies into emergency equipment suitable for attachment to helicopters are now under way. Following these studies, a critical assessment of equipment for helidecks on mobile offshore drilling units will take place.

Lifeboat Occupant Recovery System

The field trials for the Lifeboat Occupant Recovery System (LORS) finished in late 1987. A report on the program was prepared in 1988 and will be published in 1989 as part of the PERD technical series. COGLA funded the project through PERD in cooperation with Husky/Bow Valley, the U.K. Department of Energy, and the Newfoundland and Nova Scotia governments. The maximum environmental conditions encountered during the sea trials were 6.7 m seas with 28 knot winds. The LORS prototype hardware allows the lifeboat to be secured alongside the standby vessel in calm-to-moderate seas, while personnel transfer to the standby vessel.

Environmental Design Criteria

In anticipation of development projects in the southern Beaufort Sea, COGLA arranged with the Atmospheric Environment Service of the Department of the Environment to undertake storm-wind hindcasts. COGLA also made arrangements with the Department of Fisheries and Oceans to undertake wave and sea-current hindcasts. These studies produced a major comprehensive environmental database for the area and will help establish environmental design criteria for future use.

Another study will develop a computer program to evaluate design and operating strategies for floating oil-and-gas production structures subject to ice hazards and rough seas. Det Norske Veritas of Calgary is conducting the study with funds from Mobil, Elf Aquitaine, British Petroleum and COGLA.

Wave Effects on the Seabed

This research project brings geotechnical and coastal hydraulic engineering together to analyze wave-seabed interaction. Predicted seabed and subsea berm responses to wave action were compared with the behavior observed in the laboratory, especially for soil liquefaction. Future work will evaluate the relationship between sediment transport and geotechnical seabed failures caused by liquefaction and slope stability. The project will improve the ability of physical and numerical modeling techniques to predict bottom erosion and settlement of caisson-type structures.

The LORS system allows the lifeboat to be attached to the standby vessel while transferring personnel. Courtesy, Husky Oil, East Coast Project.

Seismic Hazard Maps For Canadian Frontier Regions

The safe design and operation of offshore structures must consider the risk of earthquake activity. COGLA, with funding from PERD, helped develop and produce seismic hazard maps for eastern Canadian offshore regions, and for northern (i.e., Beaufort Sea and Arctic) and western Canadian offshore regions. The maps will become part of the database used to develop a part of the new Canadian Standards Association code for the design, construction and installation of fixed offshore structures.

Geotechnics Study

COGLA and the Atlantic Geoscience Centre monitored the revisions to a Beaufort Sea geotechnics study funded under PERD. This study contributed to the regional understanding of the structure and stratigraphy of the shallow geological section and, in particular, the characteristics and thickness of the permafrost. COGLA and the industry had recommended the revisions to the project the year before.

Protection of the Environment

Caribou in the northern Yukon. Courtesy, Environment Canada, Canadian Parks Service.

East Coast

Georges Bank

On 18 April 1988 the Minister of Energy, Mines and Resources called for an environmental moratorium on drilling on Georges Bank until the year 2000. The governments of Canada and Nova Scotia agreed to incorporate the moratorium in law through amendments to their implementing legislation for the Canada - Nova Scotia accord. The amended acts will also provide for an independent public review before mid-1999 on the potential environmental and socioeconomic impacts of exploration activities on the bank.

COGLA, the Department of External Affairs and the U.S. departments of Energy and of the Interior have arranged an informal liaison to encourage the transfer of scientific and environmental impact information between the parties on issues related to Georges Bank.

Texaco continued to assess the results of the field and laboratory studies that it undertook as part of a program to evaluate whether oil and gas activities would significantly affect the Georges Bank fisheries. Studies conducted in 1987 focused on the effects of oil spills, drilling muds and cuttings, particularly on scallops and lobsters.

West Coast

Environmental Review

In January the Pacific Environmental Coordinating Committee (PECC) held its inaugural meeting. At that time, PECC confirmed its membership and approved its terms of reference. Part of its mandate is to oversee the implementation of the West Coast Offshore Exploration Environmental Assessment Panel's recommendations as reflected in the joint government response to these recommendations which was released in June 1987. PECC established a federal-provincial Technical Working Group to identify ways to implement the accepted recommendations and to identify study needs and research priorities for the West Coast offshore.

In July the Technical Working Group held a workshop to develop a plan for environmental management of offshore hydrocarbon exploration in B.C. The draft workshop action plan report was completed in November and will be tabled with PECC in January 1989 for review.

In October COGLA and the B.C. Ministry of Energy, Mines and Petroleum Resources released a detailed status report on federal-provincial activities planned or under way that respond to the *West Coast Offshore Exploration Environmental Assessment Panel Report* released in April 1986. The document reviews the status of research and development, oil-spill contingency planning, oceanographic studies, weather forecasting and impact assessment.

COGLA and the B.C. Ministry of Energy, Mines and Petroleum Resources (MEMPR) drafted terms of reference and set up an ad hoc federal-provincial advisory committee on the socioeconomic aspects of planning for offshore petroleum exploration on the West Coast. COGLA joined MEMPR in producing the fourth edition of the *West Coast Offshore Update*, a newsletter produced to inform those interested in offshore exploration activity on the West Coast. This edition, which received wide distribution throughout B.C., focused on initiatives taken by both governments to address the panel's recommendations and highlighted research activities under way.

North

Amauligak

Gulf conducted a winter oil-spill exercise with several government organizations in accordance with an ocean dumping permit issued by Environment Canada. Gulf used Amauligak F-24 crude oil on landfast ice in the Beaufort Sea. Since previous exercises usually focused on summer operations, a winter exercise was needed to examine the capabilities necessary to meet the harsh challenges of winter drilling operations. The exercise tested different burning techniques to minimize cleanup in an actual spill.

This exercise was followed by a test of the emergency notification procedures, which is part of the Amauligak contingency plan. Although the results were satisfactory, the exercise identified several areas where improvement was needed.

Land-Use Planning

COGLA continued to work closely with the Beaufort Sea - Mackenzie Delta and Lancaster Sound Regional Land Use Planning commissions. It continued to chair the government-industry Oil and Gas Working Group for Lancaster Sound Regional Land Use Planning Initiatives and provided the commissions with technical information on hydrocarbon potential, petroleum geology and exploration methods. COGLA personnel also participated in workshops held in Resolute, Iqaluit and Inuvik.

Consultations

Guidelines

COGLA, in consultation with other government departments, the oil and gas boards and the industry, finished drawing up guidelines for the treatment and disposal of waste from offshore hydrocarbon exploration and production.

COGLA evaluated and updated guidelines for:

- environmental procedures for impact assessment;
- meteorological, oceanographic and ice programs;
- contingency planning;
- explosives; and
- oil-based drilling muds.

The Drilling Fluids Lubricant Task Force completed its report on the environmental effects of using diesel oil as a drilling fluid lubricant. Consultation continued in 1988 with the oil industry to develop guidelines for oil-spill monitoring.

An oil-spill absorbent boom used to absorb Amauligak crude oil during an experimental winter oil-spill exercise in the Beaufort Sea. Courtesy, G. McCormick.

Environmental Assessment

COGLA remained an active member of the Interdepartmental Committee on Environmental Assessment and advised the Federal Environmental Assessment Review Office on reforming environmental assessment. COGLA also continued to evaluate environmental impact assessment methods and helped develop a public participation manual for environmental assessment and project evaluation.

COGLA reviewed environmental impact statements for proposed lease sales by the U.S. Minerals Management Service; COGLA reviews such lease sales when they could affect Canada.

International Drilling Conference on Wastes

COGLA played a key role in sponsoring and organizing the 1988 International Conference on Drilling Wastes held in Calgary in April. The conference provided new and practical insights into the effects of disposing and treating drilling waste discharges on land and at sea. Proceedings from the conference will be published in 1989.

Environmental Action Plan

As a member of the Intradepartmental Working Group on Environmental Issues, COGLA helped develop EMR's departmental action plan on the environment, particularly for issues associated with offshore oil and gas activities.

Protection of the Environment

Close-up of a Beaufort artificial island showing erosion by wave action. Courtesy, Environmental Studies Research Funds.

Environmental Studies Research Funds

The Environmental Studies Research Funds (ESRF) finance environmental and social studies for regulatory decision-making on oil and gas exploration and development on frontier lands. COGLA administers the program, which is funded through a levy on oil and gas companies holding interests on frontier lands. The ESRF Management Board was established in 1988 and met twice. It drew up a budget and began an evaluation study to assess program effectiveness to date as a means of planning future directions of the program. ESRF studies completed in 1988 included the following:

The Dynamics of Iceberg Grounding and Scouring (DIGS)

The study examined the dynamics and effects of four selected iceberg groundings on the Makkovik Bank in the Labrador Sea. Scientists had suspected that the rolling of an unstable iceberg altered the seabed, but this field program provided the first documented proof. The DIGS experiment suggested that splitting and subsequent rolling of icebergs likely occurs often and could be a primary cause of seabed pits. The data clearly indicated that during the scouring process not only is seabed sediment modified by iceberg keels, but also that the keel ice itself is modified. DIGS was a large-scale, multidisciplinary project, funded by ESRF and other government departments. Government, universities and the private sector participated in the project.

Beaufort Sea Artificial Island Erosion Data

This report presents the results of a field survey that measured rates of erosion of an artificial sand island in the Beaufort Sea. The data will be used to calibrate numerical models of erosion processes; the models will assist in the design of islands in the Beaufort Sea. Calibrating models with field data will result in more precise engineering specifications and a better understanding of erosion patterns and processes over time.

Guide to Dispersant-Use Decision-Making for Oil Spills in the Canadian Beaufort Sea

This document is a step-by-step guide to help the on-scene commander and dispersant decision team decide whether to use chemical dispersants on oil spills in the southern Beaufort Sea. The guide includes:

- a statement of the regulatory framework for dispersant use in the Beaufort Sea;
- practical background information on oil spills and on dispersant decision-making in the Beaufort Sea;
- a detailed guide for making dispersant decisions for Beaufort Sea spills in a crisis; and
- an appendix documenting the resource data on which the environmental sensitivity assessments in the guide are based.

Employment and Industrial Benefits

Northern Developments

The small upswing in northern activities in 1987 continued into 1988. Overall employment data reflect this increase, particularly the number of jobs held by Northerners. An important part of this activity was the expanded Beaufort Sea operations: Gulf reactivated its second offshore drilling rig, Esso conducted an intensive three-dimensional seismic program, and Amoco and other operators conducted offshore geological and geophysical work.

Farther north, Panarctic again activated its seasonal Bent Horn operation, shipping two tanker loads of crude petroleum. Part of Panarctic's production, some 1700 m^3 (3 per cent of total shipments) was sold to the Northwest Territories Power Corporation power-generation facility at Resolute, replacing costly diesel oil from southern Canada.

Increased exploration in the Mackenzie Valley, particularly seismic activity, provided more opportunities for Northerners in 1988. For example, the Chevron - Fort Good Hope joint venture created many jobs for residents in the community and surrounding areas. These activities helped compensate for the slowdown brought about when Esso completed its infill drilling program at Norman Wells.

As a result of both on-land and offshore activities, 1575 jobs were created. Northerners filled 23 per cent of these jobs. Only 25 foreign workers were employed in the North in 1988.

East Coast Developments

The signing of the statement of principles governing the Hibernia field development led to several significant contracts, such as the site surveys for the onshore construction site near Come-by-Chance and the offshore production site. In addition, three of the largest service contracts went out to bid:

- the project services contract, which included engineering design and procurement of the drilling and production facilities (i.e., topside facilities);
- the engineering design, procurement and construction contract for the gravity-base structure on which the topside facilities for Hibernia will sit; and
- the drilling facilities contract, which calls for the design, construction and operation of the two gravity-base structure mounted drill rigs, and their support equipment and modules.

Equipment being unloaded and personnel disembarking near Tuktoyaktuk, N.W.T.
Courtesy, G. McCormick.

Mobil began to conduct supplier seminars in major centres across Canada; the first one took place in St. John's, Newfoundland in December 1988. The seminars are designed to inform Canadian entrepreneurs about the timing of Hibernia contracts and the technical requirements bidders must meet to compete for the contracts.

Drilling and related activities continued steadily on the Grand Banks with employment ranging from 300 to 706 workers. Employment peaked during the first part of the year when two rigs were active. Of these workers, 98 per cent were Canadian.

One well off Nova Scotia was drilled between 27 March and 8 July. Employment peaked at 214 in May and June. Canadians made up 98 per cent of this workforce.

Employment and Industrial Benefits

Canadian Market Opportunities Program

During 1988 COGLA was invited to become a non-voting member of the board of the Canadian Market Opportunities Program (CMOP) along with Industry, Science and Technology Canada, the federal government's voting member. CMOP is a private sector program that represents the petroleum industry and its suppliers, buyers, contractors, consultants and associations. The program aims to increase the level of participation of Canadian suppliers in petroleum activities and encourages the development of domestic sources for goods and services not yet supplied by Canadians. Regional chapters from the Maritimes and Central, Western and Northern Canada meet regularly to promote CMOP goals.

Employment Equity

When the federal Employment Equity (EE) Act and its associated regulations came into force, it became evident in late 1987 and during 1988 that there were areas where the EE Act and COGLA's legislation overlapped. To reduce the reporting burden on the oil and gas industry, industry and government agreed that the EE Act would prevail for all employment equity reporting required for activities regulated by COGLA.

TOTAL 1988 PETROLEUM-RELATED EMPLOYMENT ON FRONTIER LANDS

	Total Work Force*	Canadian	Per Cent Canadian
Mainland Territories	863	863	100
Mackenzie Delta and Beaufort Sea	685	660	96
Arctic Islands and Eastern Arctic Offshore	27	27	100
Grand Banks and Labrador Sea	706	692	98
Nova Scotia Offshore	214	210	98
Total	2 495	2 452	98.3

* *Represents approximate number of jobs created.*

TOTAL 1988 PETROLEUM EXPENDITURES ON FRONTIER LANDS

	Exploration*	Development	Production	Total	Canadian	Per Cent Canadian**
		(millions of $)				
Mainland Territories	15.0	5.3	5.3	25.6	24.1	94.1
Mackenzie Delta and Beaufort Sea	126.6	–	–	126.6	101.3	80.0
Arctic Islands and Eastern Arctic Offshore	–	–	–	–	–	–
Grand Banks and Labrador Sea	159.8	–	–	159.8	94.3	59.0
Nova Scotia Offshore	31.7	–	–	31.7	18.1	57.1
Total	333.1	5.3	5.3	343.7	237.8	69.1

* *Includes geophysical expenditures.*
** *Historical estimates.*

Data Management

COGLA collects, stores and distributes information arising from geological and geophysical activities, wells drilled and the administration of exploration and development rights. COGLA personnel use the data for evaluation purposes, and make it available to industry and the public after the data are released from confidential status.

Three primary databases now provide an integrated framework for data management in COGLA.

Over the past several years, COGLA has developed and implemented digital database systems to support data management activities. The first one completed was the Land Information System. It contains data on all agreements and licences administered by COGLA. The loading of the database was completed early in 1988.

COGLA and the Canada-Newfoundland Offshore Petroleum Board jointly developed a computer-based shotpoint location system. The system is used to manage operational, statistical and geographical information for all geological and geophysical programs carried out on the frontier lands. The system was implemented in late 1987. About 800 000 line kilometres of historical location data were loaded into the database during 1988.

A system for storing and retrieving drilling and geological data for all wells drilled or being drilled was also implemented in late 1987. Base data for almost 2000 wells were included by year-end, and research and verification of information continued in 1988.

Regional Statistical Summary

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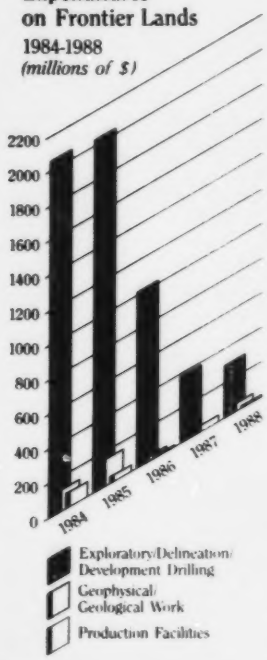
Frontier Lands

Statistical Summary

Petroleum Expenditures on Frontier Lands
1984-1988
(millions of $)



ACTIVITY STATUS ON FRONTIER LANDS	1984	1985	1986	1987	1988
Licences/Agreements (ELs/EAs/SDLs) Concluded	47	5	23	42	105
Wells Spudded	120	99	60	48	25
Metres Drilled	241 298	207 896	150 404	67 234	54 391
Wells Terminated	123	103	70	50	27
Significant Discoveries	11	25	14	1	2
Geophysical Programs Run	65	55	15	7	27
Reflection Seismic km	63 817	57 091	11 001	2 756	16 568
Rig-Months	236	199	133	41	37

FRONTIER LANDS RESOURCE INVENTORY	OIL*		GAS	
	Discovered	Potential	Discovered	Potential
	(millions of m^3)		(billions of m^3)	
West Coast	0	50	0	270
Mainland Territories	37.2	95	20.8	312
Mackenzie Delta and Beaufort Sea	253.2	1 112	308.5	1 918
Arctic Islands and Eastern Arctic Offshore	65.7	873	416.4	3 156
Hudson Bay	0	127	0	88
Grand Banks and Labrador Sea	212.0	1 192	146.8	1 286
Nova Scotia Offshore	22.9	318	162.4	663
Total	591.0	3 767	1 054.9	7 693

* *Includes condensate.*

OIL AND GAS PRODUCTION ON FRONTIER LANDS	1984	1985	1986	1987	1988
Oil Production (thousands of m^3)					
Norman Wells	175	949	1 411	1 531	1 728
Bent Horn	–	29.5	17.5	34.5	54.9
Amauligak	–	–	50	–	–
Panuke	–	–	–	3.7	–
Gas Production (millions of m^3)					
Pointed Mountain	194	226	205	156	154
Norman Wells	41	227	188	163	138

Mainland Territories

Statistical Summary

ACTIVITY STATUS	1984	1985	1986	1987	1988
Wells Spudded					
Exploratory/Delineation	18	15	14	1	3
Development	67	39	14	35	11
Total	85	54	28	36	14
Wells Terminated*					
Exploratory/Delineation	15	17	14	2	3
Development	69	38	14	36	11
Total	84	55	28	38	14
Metres Drilled	80 804	53 924	36 289	31 132	15 778
Exploratory/Delineation	28 769	23 968	24 401	974	7 095
Development	52 035	29 956	11 888	30 158	8 683
Geophysical Programs Run	20	17	7	5	9
Reflection Seismic km	5 371	5 819	2 095	149	1 729**

** In the Mainland Territories, where exploratory operations are generally restricted to the winter months, a well is deemed to be terminated in the year in which it reaches total depth, even though it may be reentered in the following year for testing.*

*** Includes three-dimensional seismic equivalent.*

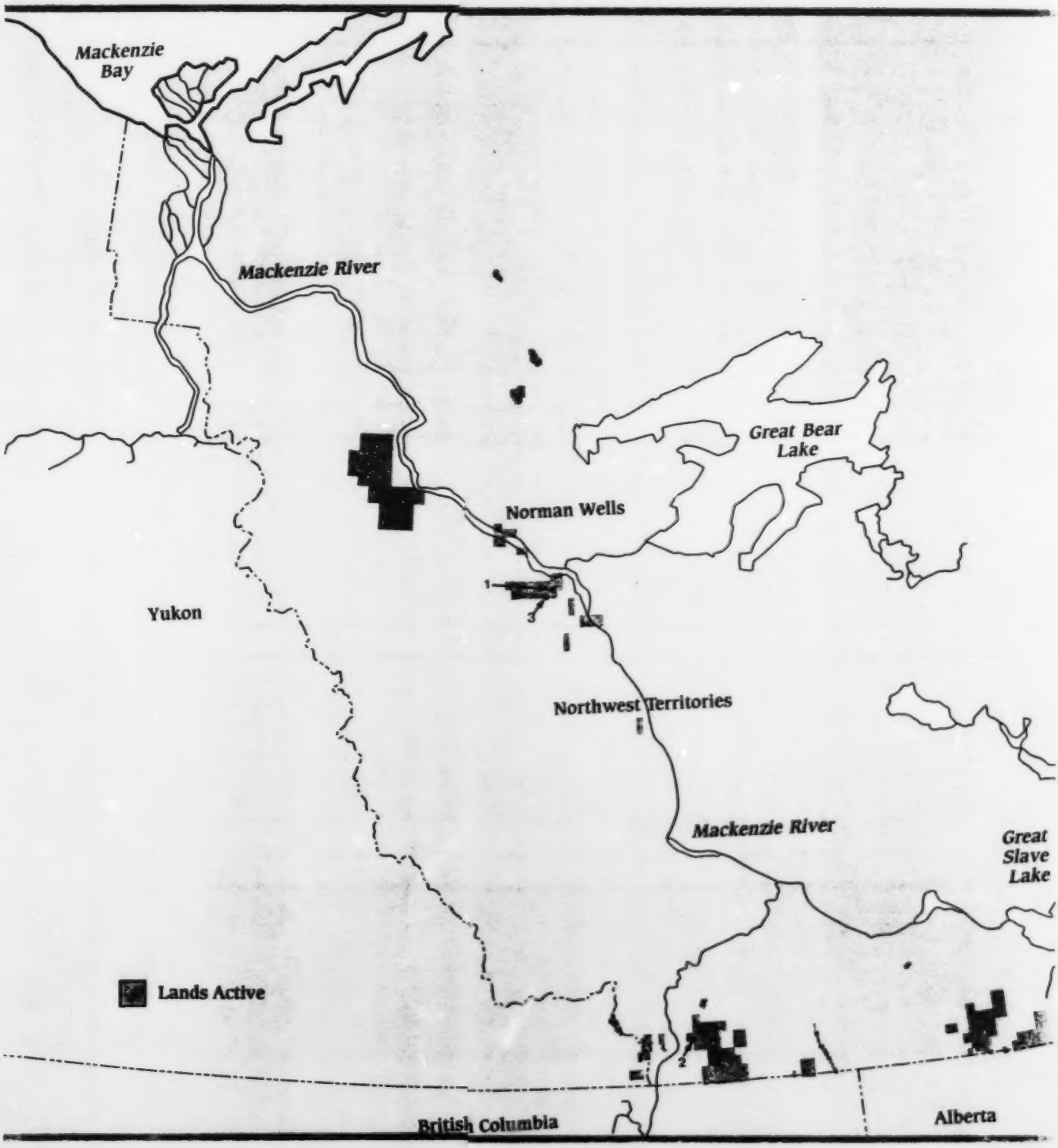
RESOURCES STATUS	1984	1985	1986	1987	1988
Discovered Resources*					
Gas (billions of m^3)	21.2	21.4	20.3	20.8	20.8
Oil (millions of m^3)	52.3	51.0	51.0	37.2	37.2
Gas and Oil Production					
Pointed Mountain Gas (millions of m^3)	194	226	205	156	154
Norman Wells Gas (millions of m^3)	41	227	188	163	138
Norman Wells Oil (thousands of m^3)	175	949	1 411	1 531	1 728

** As reported in previous years.*

BENEFITS STATUS	1984	1985	1986	1987	1988
Rigs Active	14	11	11	3	3
Rig-Months	47	31	33	13	6
Money Spent (millions of $)					
Geophysical/Geological	48.2	60.0	11.1	2.4	8.7
Exploratory/Delineation Drilling	49.5	69.3	54.1	4.4	6.3
Development Drilling	72.1	35.2	14.3	27.0	5.3
Production Facilities	86.1	23.5	5.6	30.5	5.3
Total Money Spent (millions of $)	255.9	188.0	85.1	64.3	25.6

LAND STATUS	1984	1985	1986	1987	1988
Licences (ELs/SDLs) Concluded	7	0	0	24	18
Total ELs/SDLs Active	34	34	30	29	30
Lands Negotiated into ELs/SDLs (millions of ha)	1.4	0	0	4.5	0.08
Lands Relinquished/Surrendered (millions of ha)	0.1	3.1	3.3	4.7	0.9
Lands Active (millions of ha)	12.3	9.2	5.7	2.3	1.2

Mainland Territories



Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Conoco et al East MacKay I-55	64°44'43'' N 125°39'44''W	Atco/Equtak 76	88-01-11 88-02-17	Plugged & abandoned	2 165
2.	Shell et al Arrowhead 2B-76	60°25'07'' N 122°58'38''W	Hi-Tower 21	88-01-21 88-03-13	Plugged & abandoned	2 900
3.	Conoco et al North Little Bear L-21	64°40'40'' N 125°50'25''W	Atco/Equtak 76	88-02-24 88-03-13	Plugged & abandoned	2 030

In 1988 abandonment operations were completed for the following wells:

Briggs Rabbit Lake No. 1
Briggs Rabbit Lake No. 3
CPOG et al Labiche F-08
Socony Mobil WM Birch YT B-34
Candel DEC KMG et al East MacKay B-45

Mackenzie Delta and Beaufort Sea

Statistical Summary

ACTIVITY STATUS	1984	1985	1986	1987	1988
Wells Spudded					
Exploratory/Delineation	6	19	17	3	3
Wells Terminated*					
Exploratory/Delineation	12	16	24	3	4
Metres Drilled					
Exploratory/Delineation	31 682	48 370	48 016	8 344	13 438
Geophysical Programs Run	13	8	5	1	7
Reflection Seismic km	7 959	4 700	4 756	139	11 475**

** In the Beaufort Sea, where operations are seasonal and could take place over a number of seasons for a given well, a well is deemed to be terminated in the year in which it reaches total depth.*

*** Includes three-dimensional seismic equivalent.*

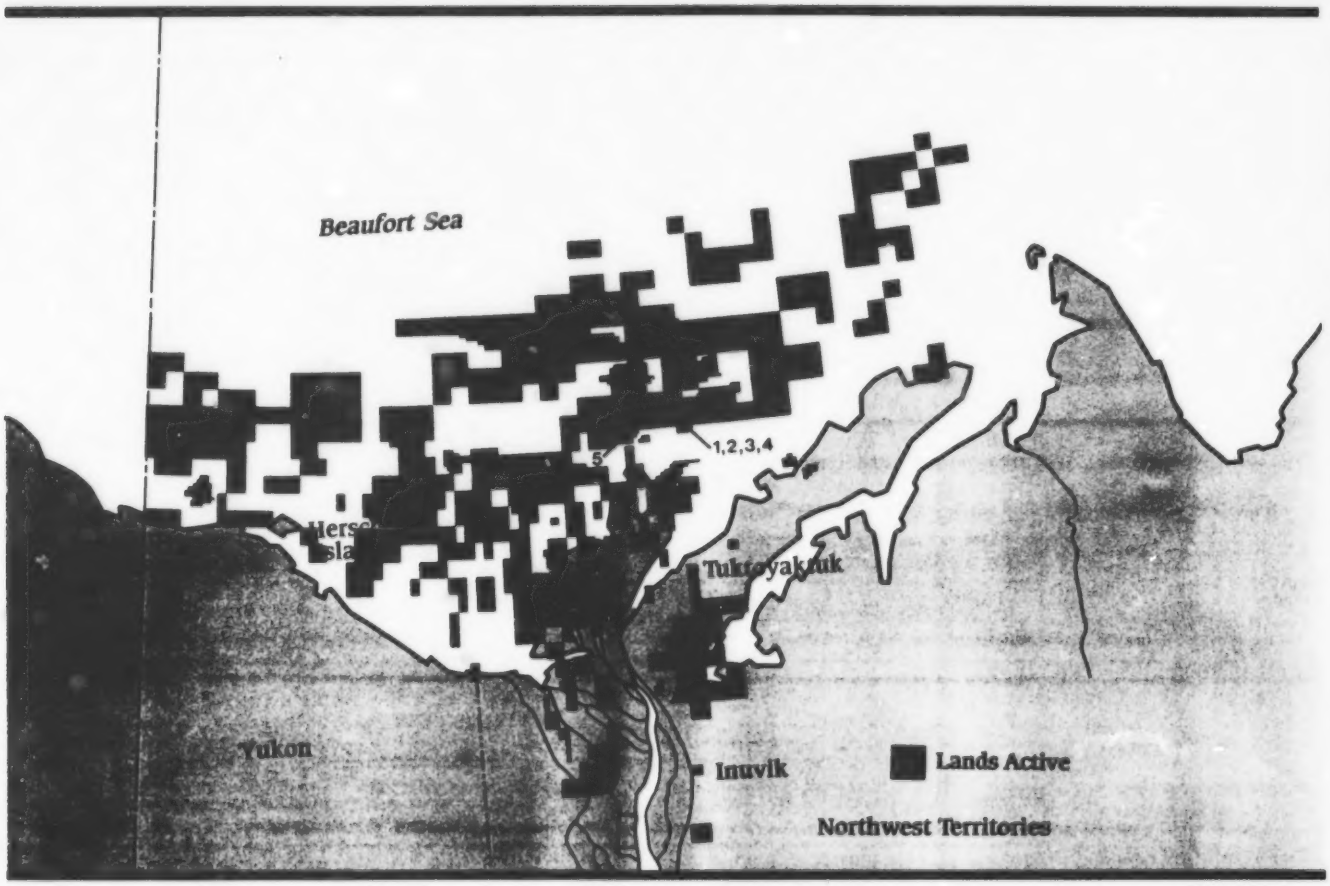
RESOURCES STATUS	1984	1985	1986	1987	1988*
Discovered Resources**					
Gas (billions of m^3)	279.5	284.2	292.8	302.1	308.5
Oil (millions of m^3)	130.4	183.1	193.2	253.2	253.2
Oil Production					
Amauligak (thousands of m^3)	–	–	50.4	–	–

** Includes new discoveries and revisions to previous estimates.*

*** As reported in previous years.*

BENEFITS STATUS	1984	1985	1986	1987	1988
Rigs Active	11	13	11	3	2
Rig-Months	39	43	43	5	10
Money Spent (millions of $)					
Geophysical/Geological	27.2	38.4	14.6	0.2	27.6
Exploratory/Delineation Drilling	786.4	760.5	391.5	108.6	99
Total Money Spent (millions of $)	813.6	798.9	406.1	108.8	126.6

LAND STATUS	1984	1985	1986	1987	1988
Licences (ELs/SDLs/PLs) Concluded	9	0	0	11	49
Total ELs/SDLs/PLs Active	24	23	23	28	59
Lands Negotiated into ELs/SDLs (millions of ha)	1.8	0	0	2.1	1.4
Lands Relinquished/Surrendered (millions of ha)	0.3	1.6	3.1	1.4	2.1
Lands Active (millions of ha)	8.9	7.3	4.2	2.9	3.4



Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Gulf et al Amauligak F-24 (Amauligak delineation)	70°03′17″ N 133°37′49″W	*Molikpaq*	87-10-01 87-12-18 88-02-18 88-04-13 88-08-10 88-08-12	Plugged & abandoned, oil & gas	5 260
2.	Gulf et al Amauligak 2F-24 (Amauligak delineation)	70°03′17″ N 133°37′49″W	*Molikpaq*	87-12-22 88-01-29	Plugged & abandoned	4 260
3.	Gulf et al Amauligak 2F-24A (Amauligak delineation)	70°03′17″ N 133°37′49″W	*Molikpaq*	88-01-30 88-02-17	Plugged & abandoned, gas	3 760
4.	Gulf et al Amauligak 2F-24B (Amauligak delineation)	70°03′17″ N 133°37′49″W	*Molikpaq*	88-04-15 88-08-07	Plugged & abandoned, oil & gas	4 577
5.	Gulf et al Amauligak O-86	70°05′48″ N 133°55′26″W	*Kulluk*	88-06-30 88-08-26	Plugged & abandoned, oil & gas discovery	3 910

In 1988 Gulf Canada Resources Ltd. drilled a corehole at the Amauligak site to determine the nature and characteristics of the subsea permafrost.

Arctic Islands and Eastern Arctic Offshore

Statistical Summary

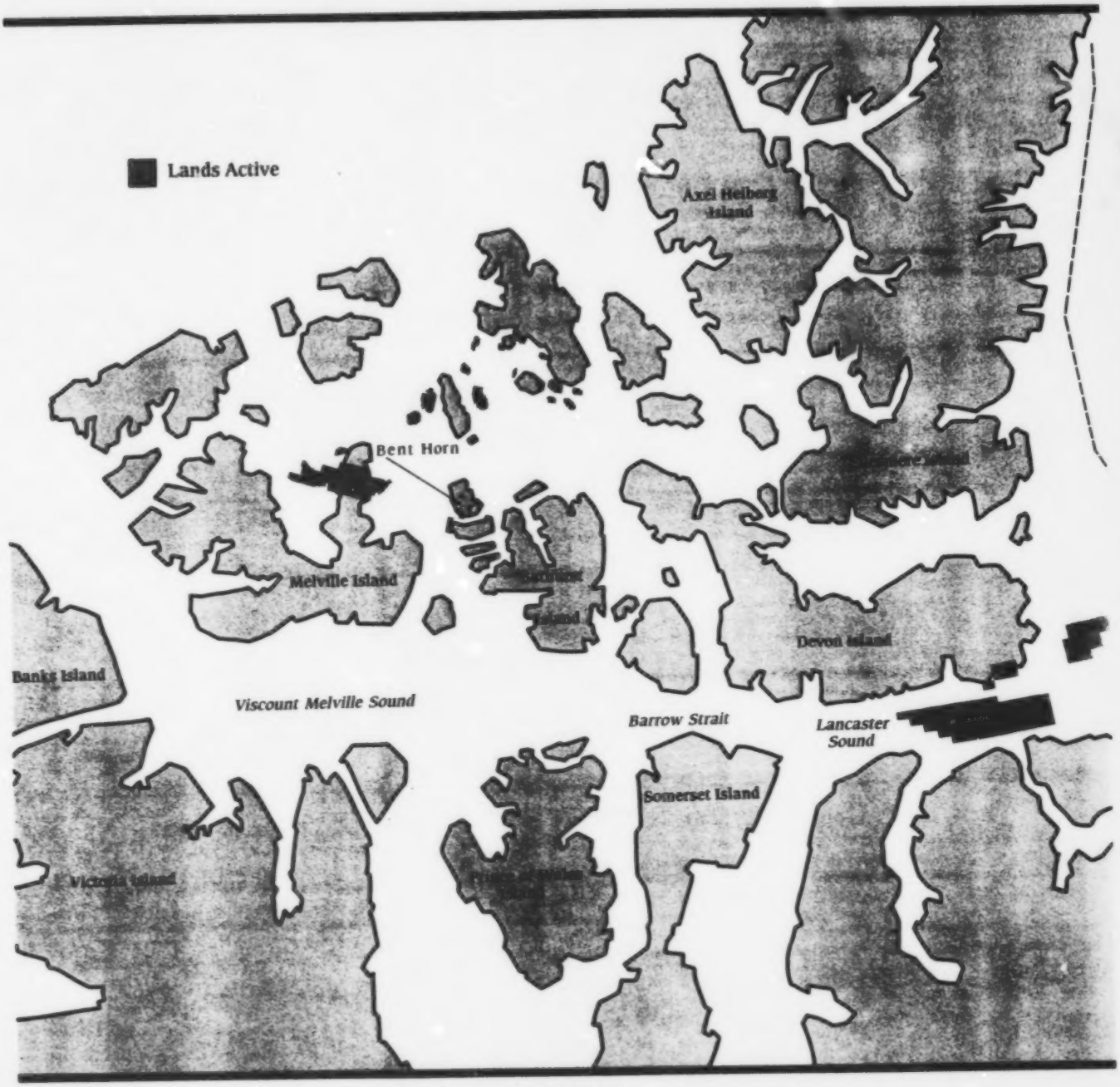
ACTIVITY STATUS	1984	1985	1986	1987	1988
Wells Spudded					
Exploratory/Delineation	3	3	2	1	0
Wells Terminated					
Exploratory/Delineation	4	3	2	1	0
Metres Drilled					
Exploratory/Delineation	11 007	6 185	4 940	689	0
Geophysical Programs Run	1	0	0	0	0
Reflection Seismic km	601	0	0	0	0

RESOURCES STATUS	1984	1985	1986	1987	1988
Discovered Resources*					
Gas (billions of m^3)	390.1	415.7	416.4	416.4	416.4
Oil (millions of m^3)	49.3	65.7	65.7	65.7	65.7
Oil Production					
Bent Horn (thousands of m^3)	–	29.5	17.5	34.5	54.9

** As reported in previous years.*

BENEFITS STATUS	1984	1985	1986	1987	1988
Rigs Active	4	3	2	1	0
Rig-Months	13	9	4	2	0
Money Spent (millions of $)					
Geophysical/Geological	4.6	0.2	0	0	0
Exploratory/Delineation Drilling	64.0	48.0	34.5	8.3	0
Production Facilities	0	7.8	0.6	0.5	0
Total Money Spent (millions of $)	68.6	56.0	35.1	8.8	0

LAND STATUS	1984	1985	1986	1987	1988
Licences (ELs/SDLs/PLs) Concluded	3	1	1	3	24
Total ELs/SDLs/PLs Active	24	25	21	16	30
Lands Negotiated into ELs/SDLs/PLs (millions of ha)	1.5	0.7	0.9	0.3	0.4
Lands Relinquished/Surrendered (millions of ha)	0.9	1.4	8.9	5.9	0.6
Lands Active (millions of ha)	15.8	15.1	7.5	1.6	1.4



In 1988 abandonment operations were completed for the BP et al Panarctic Hotspur J-20 well.

Nova Scotia Offshore (including the Gulf of St. Lawrence)

Statistical Summary

ACTIVITY STATUS	1984	1985	1986	1987	1988
Wells Spudded					
Exploratory/Delineation	14	10	6	3	1
Wells Terminated					
Exploratory/Delineation	13	14	8	3	1
Metres Drilled					
Exploratory/Delineation	71 046	47 064	29 744	9 583	5 208
Geophysical Programs Run	17	14	2	1	2
Reflection Seismic km	21 587	26 814	613	195	0

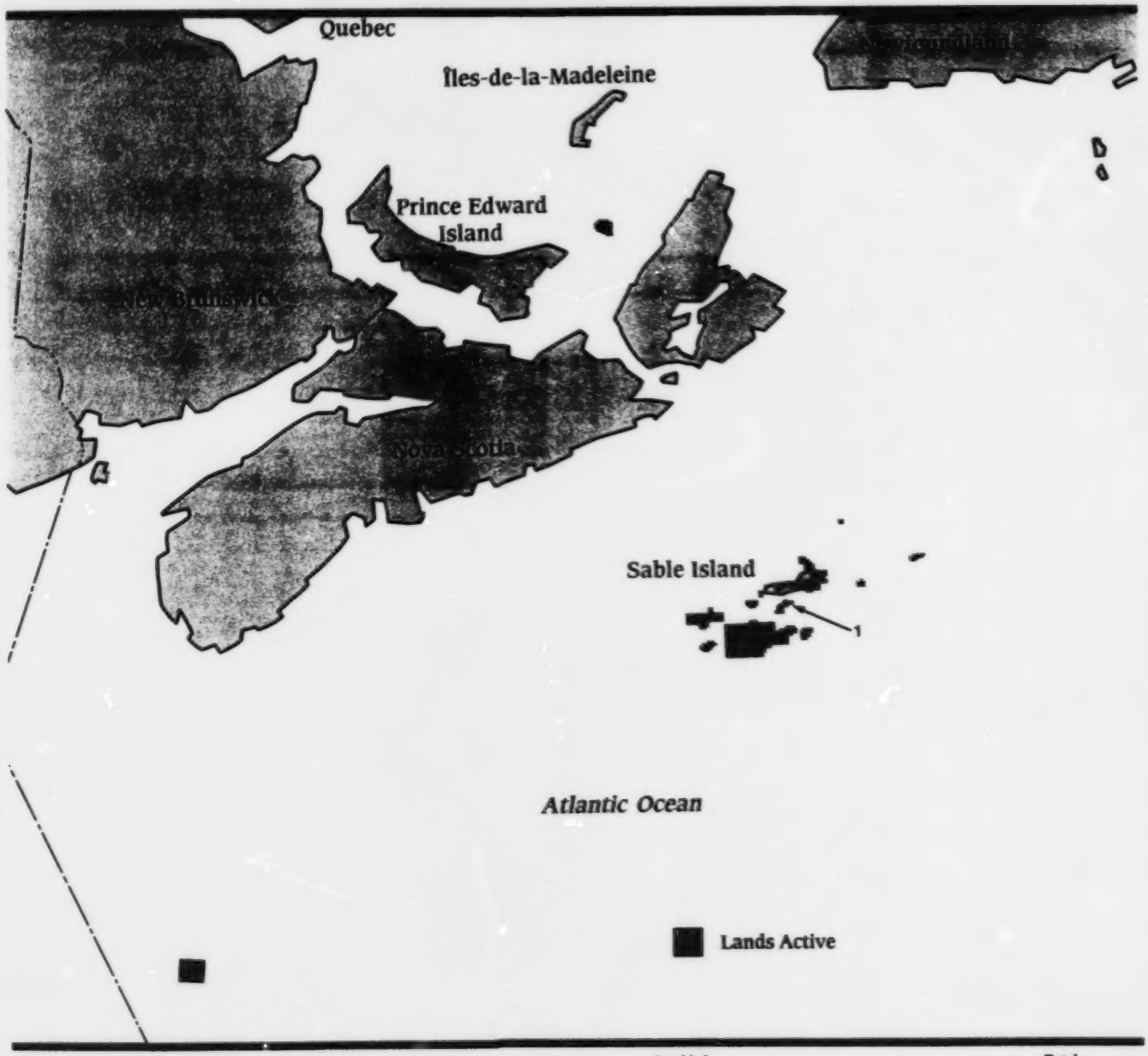
RESOURCES STATUS	1984	1985	1986	1987	1988*
Discovered Resources**					
Gas (billions of m^3)	122.6	127.4	150.6	160.9	162.4
Condensate and Oil (millions of m^3)	16.7	20.0	22.1	22.9	22.9
Oil Production (thousands of m^3)					
Panuke	–	–	–	3.7	–

* *Includes new discoveries and revisions to previous estimates.*
** *As reported in previous years.*

BENEFITS STATUS	1984	1985	1986	1987	1988
Rigs Active	10	8	5	2	1
Rig-Months	83	50	22	5	4
Money Spent (millions of $)					
Geophysical/Geological	23.2	29.2	0.9	0.2	0.2
Exploratory/Delineation Drilling	594.7	452.0	176.8	35.3	31.5
Total Money Spent (millions of $)	617.9	481.2	177.7	35.5	31.7

LAND STATUS	1984	1985	1986	1987	1988
Exploration Agreements (EAs) Concluded	15	2	13	3	1
Total EAs Active*	30	28	15	17	15
Lands Negotiated into EAs (millions of ha)	10.5	0.9	1.7	0.3	0.04
Lands Relinquished/Surrendered (millions of ha)	8.5	2.8	3.2	1.1	0.4
Lands Active* (millions of ha)	6.3	4.2	1.1	0.7	0.3

* *Includes declared significant discovery areas.*



Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Mobil et al South Sable B-44	43°53'06" N 59°51'41"W	*Rowan Gorilla I*	88-03-27 88-07-08	Plugged & abandoned. gas discovery	5 208

In 1988 abandonment operations were completed for the following wells: *Mobil Tetco Cohasset D-42*
Mobil Tetco Texaco Citnalta I-59
Mobil Texaco Pex Olympia A-12
Mobil et al Arcadia J-16

Appendix I
Newfoundland Offshore

(1986-1988 data verified by the Canada-Newfoundland Offshore Petroleum Board)

Statistical Summary

ACTIVITY STATUS	1984	1985	1986	1987	1988
Wells Spudded					
Exploratory/Delineation	12	11	7	5	7
Wells Terminated					
Exploratory/Delineation	10	13	8	5	8
Metres Drilled					
Exploratory/Delineation	46 759	49 098	31 415	17 486	19 967
Geophysical Programs Run	12	16	1	0	9
Reflection Seismic km	27 808	19 758	3 537	0	3 364

RESOURCES STATUS*	1984	1985	1986	1987	1988**
Discovered Resources***					
Gas (billions of m^3)	145.2	152.4	146.8	146.8	146.8
Oil (millions of m^3)	159.9	185.1	176.5	181.0	212.0

* *These figures have been generated by COGLA and may differ from those published by CNOPB.*
** *Includes new discoveries and revisions to previous estimates.*
*** *As reported in previous years.*

BENEFITS STATUS	1984	1985	1986	1987	1988
Rigs Active	9	8	6	2	2
Rig-Months	54	63	31	16	17
Money Spent (millions of $)					
Geophysical/Geological	27.8	27.3	4.1	0	5.2
Exploratory/Delineation Drilling	485.9	630.0	347.0	200	154.6
Total Money Spent (millions of $)	513.7	657.3	351.1	200	159.8

LAND STATUS	1984	1985	1986	1987	1988
Exploration Licences (ELs/SDLs) Concluded	13	0	9	1	12
Total ELs/SDLs Active	41	38	27	21	19
Lands Negotiated into ELs/SDLs (millions of ha)	6.0	0	1.5	0.1	0.1
Lands Relinquished/Surrendered (millions of ha)	8.6	10.9	9.2	1.8	1.0
Lands Active (millions of ha)	22.0	11.9	3.4	1.7	0.8

Baffin Island
Resolution Island
Cape Chidley
Lands Active
Atlantic Ocean
Hibernia Oil Discovery
1
2
3
4
5
6
7
8
9
Nova Scotia

Newfoundland Offshore

Statistical Summary

Map No.	Name of Well	Latitude, Longitude	Drilling Unit	Spudded, Reentered, Terminated	Status, Results	Total Depth (m)
1.	Husky/Bow Valley et al Whiterose E-09 (Whiterose delineation)	46°48′26″ N 48°01′23″ W	*Bow Drill 3*	87-08-20 87-11-11 88-01-12 88-02-22 88-04-20 88-07-01	 Plugged & suspended, oil	3 970
2.	Petro-Canada et al Terra Nova C-09 (Terra Nova delineation)	46°28′10″ N 48°30′58″ W	*Sedco 710*	87-12-06 88-03-04 88-06-15 88-08-01	 Plugged & suspended, oil	3 640
3.	Petro-Canada et al Terra Nova E-79 (Terra Nova delineation)	46°28′30″ N 48°26′43″ W	*Sedco 710*	88-03-05 88-06-14	Plugged & suspended, oil	3 605
4.	Husky/Bow Valley et al Whiterose A-90 (Whiterose delineation)	46°49′11″ N 47°57′18″ W	*Bow Drill 3*	88-07-02 88-08-11	Plugged & abandoned	3 025
5.	Mobil et al Avondale A-46	46°35′08″ N 48°36′18″ W	*Sedco 710*	88-08-01 88-08-21	Plugged & abandoned	2 025
6.	Petro-Canada et al South Brook N-30	46°19′52″ N 48°34′06″ W	*Sedco 710*	88-08-22 88-09-18	Plugged & abandoned	1 789
7.	Chevron et al East Rankin H-21	46°30′27″ N 48°48′10″ W	*Sedco 710*	88-09-19 88-10-27	Plugged & abandoned	2 150
8.	Texaco et al South Merasheen K-55	47°04′43″ N 47°53′23″ W	*Bow Drill 3*	88-10-25 88-12-22	Plugged & abandoned	3 545
9.	Texaco et al Amethyst F-20	46°39′23″ N 48°02′28″ W	*Maersk Vinlander**	88-12-25	Drilling	621

* *The* Bow Drill 3 *was renamed the* Maersk Vinlander *effective 8 December 1988.*

Glossary of Terms

Abandoned Well: Any well that has been permanently plugged.

Benefits Plan: A plan submitted by operators and approved by the minister that states the employment and procurement intentions of operators related to their exploration and development activities on frontier lands.

Berm: A submerged artificial island constructed from dredged material and designed to form a base for bottom-founded mobile structures.

Completed Well: A well that has been drilled and equipped so that it is capable of producing oil or gas.

Cubic Metre of Gas: Equivalent to 35.301 cubic feet at 14.73 pounds per square inch (760 mm of Hg) of atmospheric pressure at sea level.

Cubic Metre of Oil: Equivalent to 6.2898 American stock tank barrels.

Delineation Well: A well drilled as a follow-up to a discovery well on the same geological feature, with the purpose of determining the extent and commercial potential of the oil or gas accumulation encountered in the discovery well.

Development Plan: A development plan describes the approach and facilities that the proponent intends to use to recover hydrocarbon resources based on the proponent's interpretation of geology and reservoir characteristics of a field.

Drillstem Test: A test involving temporary completion of a well to evaluate fluid flow rates and to collect fluid samples.

Dry Hole: A well that has failed to find significant amounts of oil or gas.

Exploration Licence: A licence granting the right to explore for, and the exclusive right to drill and test for, petroleum, and the exclusive right to obtain a Production Licence subject to compliance with the other provisions of the Canada Petroleum Resources Act (formerly called an Exploration Agreement under the Canada Oil and Gas Act).

Exploratory Well: A well drilled on a geological feature where no significant discovery has previously been made (synonymous with wildcat well).

Geotechnics: The field of science that deals with the physical and mechanical properties of soil and rock for engineering purposes.

Hectare (ha): 10 000 square metres (equivalent to 2.47 acres).

Hindcasting: The application of forecasting techniques or numerical prediction models to determine past meteorological or oceanographic conditions. Databases produced by hindcasting techniques supplement the duration and spatial coverage of historical measured data. Hindcasts are used for extreme value estimation of design parameters and for climate definition.

Hydrocarbon: A naturally occurring compound consisting primarily of atoms of hydrogen and carbon, in solid, liquid or gaseous form.

Infill Drilling: Drilling of wells between existing wells to better exploit the reservoir.

Injection Well (Injector): A well in which fluids are injected into an underground formation to increase reservoir pressure.

Landfast Ice: Sea ice that forms and remains attached to the shore.

Mobile Arctic Caisson: An annular steel caisson (better known as the *Molikpaq*), with deck dimensions of 75 m × 73 m, which is designed to be set down on a underwater berm.

Mobile Offshore Drilling Unit (MODU): Any vessel capable of engaging in drilling operations for the exploration for, or the exploitation of, resources beneath the seabed.

Primary Objective: The subsurface reservoir section thought to be the most likely to contain petroleum.

Reflection Seismic: The primary geophysical technique used in petroleum exploration for mapping subsurface geological features. Acoustic pulses created at the surface are reflected from layers that have different acoustic properties within the earth. The pulses are recorded at the surface for processing and interpretation.

Rights Issuance: The process of granting an exploration licence to a company for a parcel of Crown reserve lands.

Shotpoint: The geographic location on the surface of the earth representing the centre of origin for the energy source that is discharged during a reflection seismic survey.

Significant Discovery: A discovery indicated by the first well on a geological feature that demonstrates by flow testing the existence of hydrocarbons in that feature and suggests the existence of an accumulation that has potential for sustained production.

Stratigraphy: The study of stratified rocks, especially the correlation of layers in different localities.

Suspended Well: A well in which drilling or production operations have temporarily ceased.

Terminated Well: A well that has reached total depth and has been abandoned, completed or suspended.

Waterflood: A method of recovery in which water is injected into a reservoir to remove additional quantities of oil from the reservoir.

COGLA Offices

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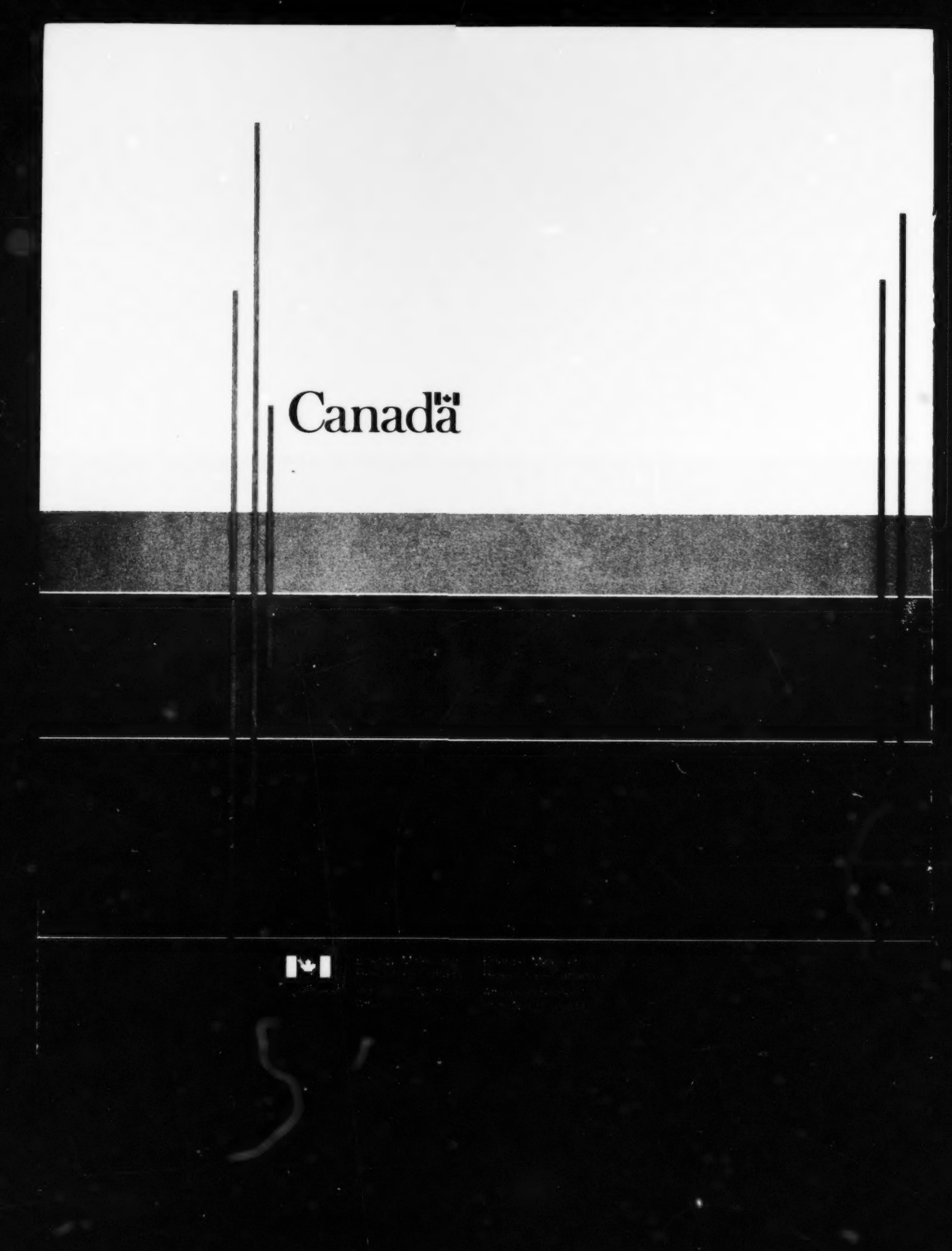
	COGLA Laboratory P.O. Box 1006 Dartmouth, Nova Scotia B2Y 4A2	Bedford Institute of Oceanography, Dartmouth, Nova Scotia	(902) 426-3179 (902) 426-2525	—	—
Northwest Territories	P.O. Box 1500 Yellowknife, N.W.T. X1A 2R3	Bellanca Building 4914-50th Street 6th Floor Yellowknife, N.W.T.	(403) 920-8175	034-45570	873-8707
Western	P.O. Box 2638 Station M Calgary, Alberta T2P 3C1	3rd Floor Merland Building 630-4th Ave. SW Calgary, Alberta	(403) 292-5631	—	—


Canada